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# Legal Issues in IP Protection for Additive Manufacturing

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## I. Introduction

Additive manufacturing ("AM") offers the power to design and create in new ways but also brings challenges in intellectual property protection and unauthorized copying, along with potential liability issues.[1] One growing problem is counterfeiting, which is recognized as part of a worldwide industry estimated at over $1 trillion.[2] "There are

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1. Ariel M. Nissan, *Regulating the Three-Dimensional Future: How the FDA Should Structure a Regulatory Mechanism for Additive Manufacturing (3D Printing)*, 22 B.U. J. Sci. & Tech. L. 267, 268 (2016).

2. *Counting the Cost of Counterfeiting: A NetNames Report*, NetNames: A CSC Company, 4 (Oct. 2015), https://www.netnames.com/assets/shared/whitepaper/pdf/NetNames-Counterfeiting-Report-A4-2015-FINAL.pdf [https://perma.cc/YN4A-9T37].

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two basic paths to creating counterfeits with 3D printing."[3] First, the print instructions, in the form of a software design file, can be stolen, shared, or mocked up.[4] Alternatively, an existing object "(including a genuine branded or licensed product)" can be 3D scanned to create a design file to print a copy.[5] "Hybrids of the two paths also exist, for example, a 3D scan version that is then altered in one or more characteristics."[6]

## II. DIGITAL, PHYSICAL, AND CHEMICAL APPROACHES TO IP PROTECTION

Digital rights management is the standard approach to protecting creative content in an electronic form.[7] However, simply requiring that the design file contain an authorization code is not enough to completely prevent 3D counterfeiting.[8] "The authorization code validates the printing process, but it leaves no trace of that validation (or the lack thereof) on the product that is generated."[9] "A physical 3D mark[, either printed or added separately,] is minimal protection because it assumes the ability to tuck away a visible mark unobtrusively."[10] An obvious physical mark can be scanned and replicated, so the knockoff will appear to be genuine as well.[11]

Given the limitations of digital and physical protections, it makes sense to explore how chemical marking might work.[12] As AM gains traction in industrial arenas such as aerospace and automotive, counterfeit products made with inferior materials present both an economic threat and public safety concerns.[13] Chemistry could be used to validate authorized print materials and curb these concerns, but simply validating chemical content of a product is generally not enough to deter sophisticated counterfeiters.[14] This method of validation used in isolation provides insufficient protection, "in the same way that it is possible to use genuine ink in a genuine printer . . . to make illegal copies of a copyrighted work, or to print a plagiarized document."[15] Therefore, a viable chemical approach must be more nuanced to be

3. Sharon Flank, Gary E. Ritchie & Rebecca Maksimovic, *Anticounterfeiting Options for Three-Dimensional Printing*, 2 3D PRINTING & ADDITIVE MANUFACTURING 180, 181 (2015) [hereinafter Flank, Ritchie & Maksimovic].
4. *Id.*
5. *Id.*
6. *Id.*
7. *See id.* at 184.
8. *Id.* at 181.
9. *Id.*
10. *Id.*
11. *Id.*
12. *Id.* at 181–183.
13. *Id.* at 181.
14. *See id.* at 182.
15. *Id.* at 181.

successful.[16] Accordingly, the chemical taggant solution described in this Article incorporates elements from digital and physical protection as well to create more robust IP protection.

Preventing counterfeit products from entering the marketplace is important to brand owners and important for public safety.[17] Brand owners want a way to ensure that the products in the marketplace are genuine, both to ensure quality and to ensure that they are getting paid for their intellectual property.[18] They see 3D printing as an opportunity and a threat.[19] It constitutes an opportunity to offer personalized, custom versions of a wide range of products, from shoes to medical implants.[20] However, it also threatens their brand, their quality, and their market: how can they distinguish a branded athletic shoe from a knockoff, or a customized medical implant from a dangerous chunk of plastic, if both are 3D printed?[21]

Brand owners currently spend millions on ensuring that their products in the marketplace are genuine, "employing quality inspectors, secret shoppers, security teams and forensic laboratories."[22] In addition, many incorporating spectroscopic and other chemical analysis tools.[23] "These teams check distributors, monitor suspect products at customs in cooperation with border authorities, and visit retailers to monitor their supply chain."[24] When knockoffs slip through, the team alerts the brand owners.[25] This may occur because an unhappy customer returns a suspect product, "often because it failed, and the brand owner's labs spend time and money searching for the cause of failure, or attempting to prove that the failed product is in fact a fake."[26] "Authentication is the fastest-growing segment of the broader anti-counterfeiting market because faster—and more portable—ways to check on products save money, time, and reputation."[27] "The existing anti-counterfeiting effort is, however, insufficient to meet the challenges of 3D printing."[28]

## III. PRINCIPLES

Real solutions to 3D IP protection must be "fast, flexible, cost-effective, scalable . . . and secure." The table below provides why these

16. *See id.* at 182.
17. *Id.* at 181.
18. *Id.*
19. *Id.*
20. *Id.*
21. *Id.* at 181–82.
22. *Id.* at 182.
23. *Id.*
24. *Id.*
25. *Id.*
26. *Id.*
27. *Id.*
28. *Id.*

principles are necessary and describes how each principle should impact the brand owner or product.

| Principles | Why? | Impact or result |
|---|---|---|
| Fast | Only fast and easy tests will be performed | Detection should take seconds, and protection should be compatible with the production environment |
| Flexible | AM is evolving and adding materials and methods | Multi-material solutions have a better chance in the marketplace |
| Cost-effective | Everyone wants IP protection, but no one wants to spend a lot of money to get it | Solutions should add less than 2% to product price |
| Scalable | AM will not be limited to small batches for much longer | Setup and detection should not require cumbersome equipment or processes |
| Secure | Security that does not protect wastes everyone's time and money | It should not be possible to counterfeit the anti-counterfeiting. Covert measures are stronger because fewer people need to know about them. |

## IV. PROTECTING THE FILE IS NOT ENOUGH

3D designs are vulnerable to theft and compromise, including via cybersecurity breaches and insider personnel.[29] These are real concerns: if you can get your hands on the Computer Aided Design ("CAD") or .stl files for 3D printing, you can create an object that is essentially indistinguishable from the real thing.[30] Arguably, it *is* the real thing, at least if it is made the same way with the same materials on the same type of printer.[31]

However, additive manufacturing adds another layer of threat.[32] A counterfeiter or saboteur does not need to have the original design file to replicate an object.[33] Instead, they can 3D scan a genuine article to create their own version of a design file, and then continue on their own to make identical copies.[34] For the IP owner, this form of copying is equally disturbing: a competing object enters the marketplace to

29. *3D Opportunity and Cyber Risk Management Additive Manufacturing Secures the Thread*, DELOITTE UNIVERSITY PRESS, https://dupress.deloitte.com/content/dam/dup-us-en/articles/3292_3D-opportunity-cyber-risk-mgmt/DUP_3D-opportunity-risk-management.pdf [https://perma.cc/XQJ2-9UD6] [hereinafter *3D Opportunity and Cyber Risk Management*].
30. Thomas Kurfess & William J. Cass, *Rethinking Additive Manufacturing and Intellectual Property Protection*, 57 RES.-TECH. MGMT. J., no. 5, 2015, at 37 [hereinafter Kurfess & Cass].
31. *See id.*
32. *See 3D Opportunity and Cyber Risk Management*, *supra* note 29, at 6.
33. *See* Kurfess & Cass, *surpa* note 30, at 36.
34. Flank, Ritchie & Maksimovic, *supra* note 3, at 181.

compete with their genuine version.[35] It will look similar, but it might be made of inferior materials or to lesser specifications.[36] It may mimic their trade dress and violate their trademark, compromising their profit as well as jeopardizing their brand and reputation for quality. It may violate their patent rights by pretending to be "generic" or "compatible," like the Apple iPhone chargers available on the internet that were recently shown to be 90% fake.[37] And, like those chargers, such products may raise liability issues by catching fire, or breaking off sharp or choking-hazard pieces.[38]

## V. PROTECTING THE OBJECT: QUICK TECHNICAL OVERVIEW

Ensuring the integrity of additive manufacturing will require cybersecurity and file protections, but real security also demands a technical solution for authenticating real objects. In the short term, the major area of concern is spare parts. For example, a person does not want to be in jeopardy from an inferior fake brake. Particularly, defense, aerospace, and automotive companies do not want to face liability charges because they have failed to make it possible to distinguish safe, genuine products. "Encoding the instructions for materials tagging into the design file makes it possible to use software controls (authorized secure downloads) to limit proliferation of physical copies."[39]

### A. *Taggants*

One of the key anti-counterfeiting methods is the use of taggants, which are generally chemical markers that are invisible to the eye but detectable with some special method.[40]

### B. *Advantages and Disadvantages*

A covert measure offers the advantage that the would-be counterfeiter has no clue that it is present or where to find it.[41] Covert measures make it harder for a counterfeiter to replicate the object because

35. *See* Kurfess & Cass, *surpa* note 30, at 37.
36. *Id.*
37. *E.g.* Amit Chowdhry, *Apple: Nearly 90% Of 'Genuine' iPhone Chargers On Amazon Are Counterfeit*, WORLD NEWS (Oct. 24, 2016) https://breaking.com.ng/world news/apple-nearly-90-of-genuine-iphone-chargers-on-amazon-are-counterfeit/ [https://perma.cc/CN6Y-9RSB].
38. *What You Need to Know About Deadly Counterfeits*, CONSUMER REPORTS (Aug. 18, 2015, 1:00 PM), http://www.consumerreports.org/cro/news/2015/08/deadly-counterfeits/index.htm [https://perma.cc/UXG7-ZHLH]; *see generally* VICTORIA A. ESPINEL, INTELLECTUAL PROPERTY ENFORCEMENT (2010): ANNUAL REPORT OF THE U. S. INTELLECTUAL PROPERTY ENFORCEMENT COORDINATOR, 42 (2011), https://www.ice.gov/doclib/iprcenter/pdf/ipec-annual-report.pdf [https://perma.cc/5WWP-UTLU].
39. Flank, Ritchie & Maksimovic, *supra* note 3, at 181.
40. *Id.*
41. *Id.* at 184.

the counterfeiter must replicate the anti-counterfeiting taggant. When taggants are too obvious, counterfeiters can find and copy them easily: if genuine products have a blue stripe, soon fake products will sport a blue stripe too.[42] Similarly, if genuine product shows taggant under ultraviolet light, counterfeiters will use UV taggant too. Unfortunately, it is also possible to err in the other direction by making taggants too complex. Scalability suffers when the taggant has rare ingredients that have limited sources or when the taggant needs to be specially manufactured.[43]

Ease of detection affects cost, scalability, and ultimately security. For example, easy tests are performed frequently, while complex, time-consuming, or destructive analysis is rarer, so more counterfeited products can slip through the cracks. It might seem that the best tests are consumer-level checks, perhaps with a smartphone.[44] However, experience in the pharmaceutical industry suggests that the last professional with a stake in quality is the right person to rely on for authentication. Most U.S. prescription vials now include a description of the physical properties of the drugs inside, e.g. "oval white tablet."[45] As a thoughtful, careful consumer, do you make a habit of checking those descriptions so you can avoid fakes and mistakes? Most people do not: we are in a hurry, and we depend on quality checks by others.

From a legal standpoint, a harmed consumer has standing to seek a remedy, but unless the harm is physical or egregious, they are unlikely to do so. It is the brand owner who has the most to lose, in terms of market harm to sales and reputation, and therefore it is the brand owner who is most likely to invest in protections, whether under mandate or not.[46]

### C. *Chemical Anti-Counterfeiting*

Additive manufacturing can draw on some of the experience in the broader anti-counterfeiting arena.[47] Many products, including luxury goods and licensed products (e.g., team merchandise) have relied on visible marks to reassure consumers. These include holograms on tags and packaging, and even in the product, along with color-shifting inks and marks detectable under ultraviolet light.[48] Unfortunately, counterfeiters have moved into counterfeiting the anti-counterfeiting. All those measures have been compromised. One major U.S. pharmaceutical company reported that when it introduced a new drug, the coun-

42. *Id.*
43. *Id.* at 182.
44. *See generally id.*
45. *See generally id.*
46. *Id.*
47. *Id.*
48. Ian Lancaster, *Trends: Holograms and Anticounterfeiting*, PHARMTECH.COM (Apr. 2, 2008), http://www.pharmtech.com/trends-holograms-and-anticounterfeiting [https://perma.cc/6EN8-SFW9].

terfeit was already in place. The counterfeiters had put a hologram on the package; although, the genuine product did not use a hologram.[49] To the company's frustration, consumers showed a preference for the real-seeming product—the counterfeit with the hologram.[50] Although consumers can be reassured with an overt mark, the counterfeiter benefits from being told exactly what needs to be copied.

Beyond the standard overt/covert dichotomy, additive manufacturing presents additional constraints. Packaging protections are not particularly relevant because most 3D printing processes involve heat, limiting some technological solutions such as DNA-based taggants.[51] The availability of 3D scanning makes visible marking far less useful because any mark you can put on the outside of an object can be scanned and therefore replicated on the fake object as well.[52]

### 1. UV or Fluorescence

Ultraviolet or fluorescent taggants are a good first-line protector but are broadly available to counterfeiters and often spoofed.

### 2. Chemical Fingerprinting

One authentication solution garnering attention uses covert chemical tagging.[53] In a multi-material build, it is possible to include a small amount of a different chemical mix as an under-the-skin chemical taggant.[54] InfraTrac's chemical fingerprinting hides a covert taggant inside the matrix print material like a spot of peanut butter and jelly inside a 3D printed sandwich (as illustrated below).[55] For polymers, the detector of choice is a near-infrared ("NIR") spectrometer, now available from several vendors in highly accurate, pocket-sized versions.[56] One advantage to InfraTrac's method is that NIR spectros-

49. *Id.*

50. *Id.*

51. *See generally* Fabbaloo, *3D Printing with DNA-Based "Smart Glue"*, ENGINEERING.COM (Feb. 12, 2015), http://www.engineering.com/3DPrinting/3DPrintingArticles/ArticleID/9576/3D-Printing-with-DNA-Based-Smart-Glue.aspx [https://perma.cc/W2X7-2L2P].

52. *See* Sarah Anderson Goehrke, *Anti-Counterfeiting Measures Have a Lot to Offer in 3D Printing – A Few Questions For: IntraTrac*, 3DPRINT.COM (Feb. 26, 2016), https://3dprint.com/121550/a-few-questions-for-infratrac [https://perma.cc/P758-36N7] [hereinafter Goehrke].

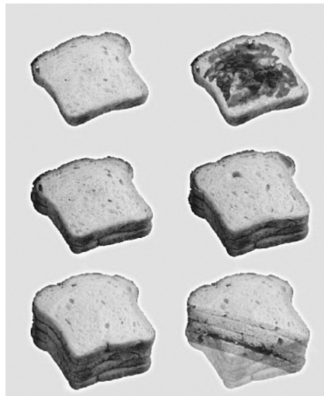
53. *See generally Available Authentication Technologies for the Prevention and Detection of SSFFC Medical Products*, World Health Organization, http://www.who.int/medicines/regulation/ssffc/mechanism/A70_23-en15-32.pdf [https://perma.cc/NBW6-XUT3].

54. Goehrke, *supra* note 52.

55. *Id.*

56. *See generally NIR Spectroscopy Unbound*, OCEAN OPTICS (Feb. 18, 2016), https://oceanoptics.com/nir-spectroscopy-unbound [https://perma.cc/5F8Y-D24T].

copy fingerprints the whole sandwich, so a "genuine" reading is a robust match of the object's material profile.[57]


[58]

A 3D scanner only sees the shape, color, and texture—not chemical composition—so a covert chemical fingerprint will not be replicated in the copy.[59] Chemical analysis techniques, including spectroscopy, are increasingly portable and easy to use, making authentication possible in the field, not just in the lab.[60] The techniques of choice are non-destructive and instant, because a point-and-shoot test has multiple advantages. First, easy tests are more likely to be integrated into standard procedures and less likely to be skipped. The Global Pharma Health Fund sent Minilab test kits to Africa and was frustrated by the fact that the fastest, easiest—but least accurate—test in the kit received the most use.[61] Second, a fast, non-destructive test can be repeated at customs or in front of a jury, conveying that the item is counterfeit.

Spectroscopy is ideal for anti-counterfeiting because it is not a single-ingredient test.[62] Instead, spectroscopy looks for a match to a stored profile—a gold standard. That is, for an object consisting of ABCDEF, it looks for a match (within a specified percentage) of ABCDEF. Other taggant schemes that look for a marker, i.e., "Is

57. *See CAMO Software Partners With InfraTrac to Provide Anti-Counterfeiting Solutions to the Pharmaceutical Industry*, CAMO (Feb. 28, 2009), http://www.camo.com/news-events/press-release/Partner-InfraTrac-anti-counterfeiting-solutions.html [https://perma.cc/7URM-E5SJ].

58. Goehrke, *supra* note 52.

59. Flank, Ritchie & Maksimovic, *supra* note 3, at 184–86.

60. Ravi Kalyanaraman et al., *Portable Spectrometers for Pharmaceutical Counterfeit Detection*, AM. PHARMACEUTICAL REV. (2010), http://www.americanpharmaceuticalreview.com/Featured-Articles/116641-Portable-Spectrometers-for-Pharmaceutical-Counterfeit-Detection/ [https://perma.cc/3PRS-Q632].

61. *See generally* The GPHF-Minilab™ - Protection Against Counterfeit Medicines, (last visited 03/31/17) https://www.gphf.org/en/minilab [https://perma.cc/8WCW-PE9E].

62. Flank, Ritchie & Maksimovic, *supra* note 3, at 183.

there any C in that ABCDEF?" are more vulnerable to spoofing. For example, infant formula in China was tested for protein content, but cheaper melamine plastic powder gives a false positive result, and is, unsurprisingly, a dangerous ingredient with harmful consequences.[63] Similarly, diethylene glycol has been used as a cheap substitute for glycerin in toothpaste, with sometimes toxic effects. Both were cases of looking for a marker, a "C" in the ABCDEF matrix, rather than a full chemical match of all of ABCDEF.[64]

A widely-used printer for additive manufacturing applications comes from Stratasys and uses fused deposition modeling ("FDM").[65] This is the printer used for the tests shown below, with tests on other materials and printers detailed in previous work.[66] Stratasys provides a broad set of thermoplastics compatible with its FDM printer.[67] A test keyring of samples was procured through InfraTrac's America Makes Challenge award, and tests were performed to determine two outcomes: first, whether it was possible to use spectroscopy to distinguish the print materials, and second, whether they could be sandwiched to create a covert internal fingerprint using InfraTrac's patented approach.

63. *Questions and Answers on melamine*, WORLD HEALTH ORGANIZATION, http://www.who.int/csr/media/faq/QAmelamine/en/ [https://perma.cc/CA6X-QPTY]; *FDA Advises Consumers to Avoid Toothpaste from China Containing Harmful Chemical FDA Detains One Contaminated Shipment*, U.S. FDA, https://wayback.archive-it.org/7993/20170113085659/ http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/2007/ucm108927.htm [https://perma.cc/V5Y3-FUQS].

64. *See* Tong Wu, et al., *Identification and Quantitation of Melamine in Milk by Near-Infrared Spectroscopy and Chemometrics,* 2016 J. SPECTROSCOPY 1, 3 (2016), https://www.hindawi.com/journals/jspec/2016/6184987/ [https://perma.cc/TV2D-4UVR]; Ian Robertson, *Detection of Adulteration of Glycerol with Diethylene Glycol by Infrared Spectroscopy,* PERKIN ELMER 2–3 (2014), https://www.perkinelmer.com/lab-solutions/resources/docs/APP_Detection_Adulteration_Glycerol_DiethyleneGlycol_IR.pdf [https://perma.cc/3S86-UD9G].

65. *FDM Technology*, STRATASYS (2017), http://www.stratasys.com/3d-printers/technologies/fdm-technology [https://perma.cc/DM4Q-F63D].

66. Flank, Ritchie & Maksimovic, *supra* note 3, at 184.

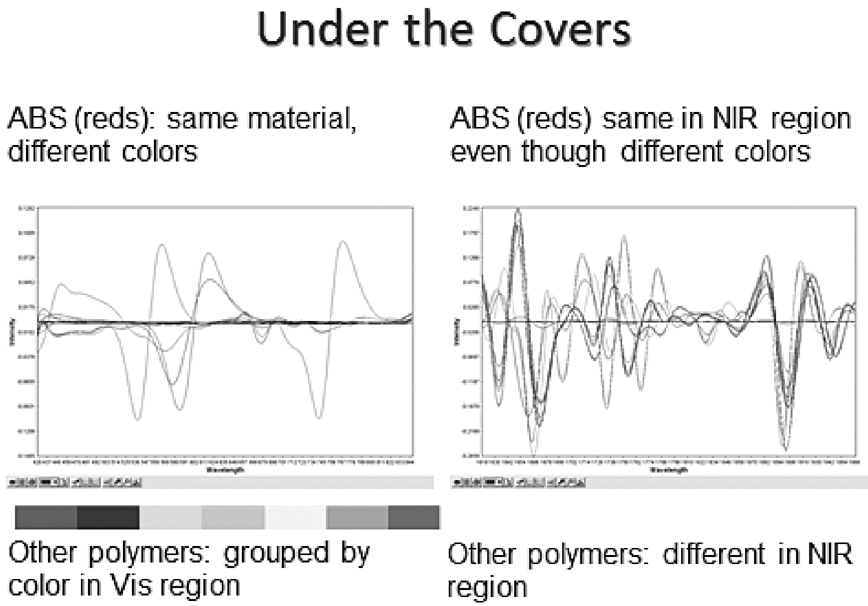
67. *FDM Thermoplastics*, STRATASYS (2017), http://www.stratasys.com/materials/fdm [https://perma.cc/V3SK-SVFG].


White plastic is white plastic . . . or is it? In the visible light region, the spectrometer sees what your eye sees. In the near-infrared, the spectrometer sees chemical composition.

The keyring contains a range of materials, but the most common—and the material used in the brightly colored samples—is acrylonitrile butadiene styrene ("ABS"). This hard plastic is familiar because it is used to make most Lego bricks.[68] The graphs below show how two materials might *look* the same but not *be* the same, using two kinds of chemical spectroscopy for analysis. In the visual range (400-700nm, marked with a violet-to-red rainbow), the spectrometer sees what the

68. Jacob Koffler, *Lego Wants to Replace Plastic Blocks with Sustainable Materials*, TIME, June 23, 2015, http://time.com/3931946/lego-sustainable-materials/ [https://perma.cc/ELU3-K9KP].

human eye sees,[69] but in a different wavelength range. In the near-infrared range, the spectrometer sees chemical bonds.[70] In the visual range, colors will show up differently but materials will not be distinguishable.[71] In the near-infrared, materials will show up differently, but colors will not be distinguishable.[72]




D. *How Are Materials Suppliers Relevant to the Solution?*

The availability of high-quality materials will drive the adoption of additive manufacturing.[73] Those AM products will need to be marked—likely chemically—to protect the intellectual property in the proprietary materials.[74] Forward-looking printer companies, and the

69. *Light and photosynthetic pigments*, KHANACADEMY, https://www.khanacademy.org/science/biology/photosynthesis-in-plants/the-light-dependent-reactions-of-photosynthesis/a/light-and-photosynthetic-pigments [https://perma.cc/ND8C-9FQC].

70. See A.M.C. Davies, *An Introduction to Near Infrared (NIR) Spectroscopy*, IM PUBLICATIONS, https://www.impublications.com/content/introduction-near-infrared-nir-spectroscopy [https://perma.cc/2SD2-BCJG].

71. *See generally* William Reusch, VIRTUAL TEXTBOOK OF ORGANIC CHEMISTRY, VISIBLE AND ULTRAVIOLET SPECTROSCOPY (1999) https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/Spectrpy/UV-Vis/spectrum.htm [https://perma.cc/E6Y3-RYNL].

72. *See generally* A.M.C. Davies, *supra* note 70.

73. Simon Ford & Mélanie Despeisse, *Additive Manufacturing and Sustainability: An Exploratory Study of the Advantages and Challenges*, 137 J. OF CLEANER PRODUCTION 1573, 1581 (2016), http://www.sciencedirect.com/science/article/pii/S0959652616304395 [https://perma.cc/58BZ-9DHK].

74. Thomas Prock, *Additive Manufacturing – IP Challenges in Modern Day Manufacturing*, MARKS & CLERK (Dec. 12, 2016), https://www.marks-clerk.com/Home/

materials companies that supply them, will offer pre-vetted sets of matrix materials and taggants, with custom mixes available for additional security.[75] As more complex materials can be 3D printed, the opportunity expands: electronics can be printed directly into plastics,[76] as well as into biologic tissue.[77]

## VI. PROTECTING THE OBJECT: LEGAL IMPLICATIONS

Existing precedent concerning anti-counterfeiting suggests a working model for IP protection as well as enforcement that can be extended to additive manufacturing.[78] Under 18 U.S.C. § 2320, the legal remedies against the trafficking of counterfeit goods or services include criminal prosecution, civil seizures, import penalties, and enhanced civil damages.[79]

Much of the current enforcement effort is geared to halting infringing goods at U.S. borders, a good model when foreign counterfeit goods are created cheaply in foreign countries and imported.[80] It is, however, possible that 3D printing will disrupt this assumption as it disrupts manufacturing, since it facilitates small-scale, distributed control of counterfeited goods manufacturing.[81]

Some of the successful prosecutions for selling counterfeit goods have gone after large marketplaces such as Alibaba and eBay.[82] Although the actual creators of the counterfeit goods are hard to locate, they still need access to legitimate markets to sell their products. In the emerging 3D printing market, it is reasonable to expect that enforcement targets will also include larger players. In particular, users of components and spare parts are highly motivated to protect them-

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Knowledge-News/Articles/3D-printing-Additive-Manufacturing-challenges.aspx#.WNgnUmUmFlI [https://perma.cc/K7S7-ACL5].

75. Michael Molitch-Hou, *Best 3D Printer Materials: Carbon Fiber Edition*, ENGINEERING.COM (Aug. 23, 2016), http://www.engineering.com/3DPrinting/3DPrintingArticles/ArticleID/12957/categoryId/20/Best-3D-Printer-Materials-Carbon-Fiber-Edition.aspx [https://perma.cc/CA2P-49XL].

76. J.E. Pierce & S. J. Schwarz, *IP Strategies for the Rise of 3D Printing*, VENABLE LLP (Apr. 14, 2015), https://www.venable.com/ip-strategies-for-the-rise-of-3d-printing-04-14-2015/ [https://perma.cc/ND49-7V6K].

77. *3D Bioprinting of Living Tissues*, WYSS INSTITUTE, https://wyss.harvard.edu/technology/3d-bioprinting/ [https://perma.cc/YQ26-XBBP].

78. *See generally* 18 U.S.C. § 2320 (2017) (showing the legal framework concerning the trafficking of counterfeit goods or services).

79. *Id.*

80. *See Intellectual Property Rights Seizure Statistics*, HOMELAND SECURITY (2014), https://www.cbp.gov/sites/default/files/documents/2014%20IPR%20Stats.pdf [https://perma.cc/96G8-S4WZ].

81. *Id.*

82. *See* Gillian Wong, *Alibaba Sued Over Alleged Counterfeits*, THE WALL STREET JOURNAL (May 17, 2015), https://www.wsj.com/articles/alibaba-sued-over-alleged-counterfeits-1431877734 [https://perma.cc/94CB-PSYM]; *see also* Doreen Carvajal, *EBay Ordered to Pay $61 Million in Sale of Counterfeit Goods*, N.Y. TIMES (July 1, 2008), http://www.nytimes.com/2008/07/01/technology/01ebay.html [https://perma.cc/872A-X9RB].

selves as well as their customers against potentially inferior or even dangerous counterfeits. We consider some examples below.

### A. *Example A: Marked Parts*

A toaster explodes and injures Alex. The toaster, made by TOASTERS, Inc., is found to include a defective 3D-printed part that failed and caused the explosion. Is TOASTERS, Inc. liable? TOASTERS, Inc. claims that GREAT3DPARTS supplied the part to them. Is GREAT3DPARTS liable? GREAT3DPARTS assert that its parts never fail, and in fact, the part that was in the offending toaster was not theirs at all. Additionally, GREAT3DPARTS asserts that TOASTERS, Inc. received the part from a distributor, MIDDLE, and that both MIDDLE and TOASTERS, Inc. failed to check that the part was genuine.

When all the companies involved do not take responsibility, which of them is liable for the exploding toaster? If GREAT3DPARTS marks its parts and makes it possible to authenticate them, it avoids liability. If TOASTERS, Inc. requires that their suppliers mark their parts and that distributors like MIDDLE check parts, it avoids liability.

In this example, it becomes evident that the ease of authentication has an influence on enforcement. If authentication is a complex, lab-based process requiring expert scientists, neither TOASTERS, Inc. nor its distributor MIDDLE are likely to take on the burden of testing. However, if they expect major losses, either from counterfeiters eating into their profits or from liability lawsuits, they may invest in this type of authentication process.

### B. *Example B: Unmarked Parts*

Consider the same exploding toaster, supplied the same way, but with no anti-counterfeiting mark. Alex asserts that TOASTERS, Inc. sold a defective and dangerous product. TOASTERS, Inc. looks to MIDDLE (who supplied the part) and GREAT3DPARTS, who may or may not have been its creator. None of them can show the offending part was not theirs. They cannot even show that they exercised care to protect the consumer from supply chain threats. TOASTERS, Inc., MIDDLE, and GREAT3DPARTS are all exposed to liability—and Alex has been exposed to real danger—from unmarked 3D printed parts.

### C. *Example C: Defense Procurement*

Counterfeit electronic parts are a major issue plaguing the U.S. Department of Defense, and the emergence of 3D printed electronics threatens to make the problem far worse.[83] Non-3D testing now relies on SAE AS6171.[84] Charged with managing counterfeit electronic parts, the Defense Logistics Agency ("DLA") requires that contractors police their suppliers and document the results of either traceability or a test on DLA L&M Form 918. This process requires a chain of suppliers policing their own suppliers and provide documentation.[85] To some extent this approach relies on the good faith of the contracting community—perhaps a lot to ask as counterfeiting becomes ever easier and more lucrative.

### D. *Advantages of Non-Destructive Testing: Juries and More*

It seems clear that there will be a growing need for testing and authentication as replication (authorized or not) becomes easier. It is worth noting that *non-destructive tests* offer considerable advantages in the field and in court. A juror who sees a chemical test is more likely to be convinced than a juror who hears an expert witness testify about what happened in a lab test. Currently, U.S. Customs and Border Protection helps protect the United States' IP by performing selected field-friendly tests themselves.[86] Fast, easy, and non-destructive tests serve their needs as well.

## VII. LOOKING AHEAD

There is no doubt that additive manufacturing can have transformative effects in a wide range of industries.[87] In a future in which everyone wears well-fitted, custom shoes, and spare parts are always "in stock," perhaps the most exciting developments will come in the medical arena, as stem cell printing joins with embedded sensors and electronics. Technological advances will offer new opportunities to define what a genuine product might be. In addition, a new territory for ethics and IP law will emerge.

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83. *See* Symposium on Counterfeit Parts and Materials, *Counterfeit Electronic Parts and Electronic Supply Chain Symposium*, SMTA, (Mar. 24, 2017), http://www.smta.org/counterfeit/tech.cfm [https://perma.cc/3N7S-8JVM] (The U.S. Department of Defense devotes considerable attention to the issue of counterfeit electronics).

84. *Test Methods Standard; General Requirements, Suspect/Counterfeit, Electrical, Electronic, and Electromechanical Parts*, SAE INTERNATIONAL, http://standards.sae.org/wip/as6171/ [https://perma.cc/U35B-UXPV].

85. *See Counterfeit Detection and Avoidance Program (CDAP)*, DEFENSE LOGISTICS AGENCY, http://www.dla.mil/LandandMaritime/Business/Selling/Counterfeit-Detection-Avoidance-Program/ [https://perma.cc/92SC-MQB2].

86. *See Headquarters Laboratories and Scientific Services Directorate*, U.S. CUSTOMS AND BORDER PROTECTION, https://www.cbp.gov/about/labs-scientific-svcs/org-operations [https://perma.cc/7BX2-6RK6] (last updated Feb. 28, 2017).

87. *See* Thomas Campbell, *3D Printing Will Be a Counterfeiter's Best Friend*, SCIENTIFIC AMERICAN (Dec. 5, 2013) https://www.scientificamerican.com/article/3-d-printing-will-be-a-counterfeiters-best-friend [https://perma.cc/PB7W-56WC]; *See also* Ritchie Flank, *Anti-Counterfeiting Options for 3D Printing*, 2 3D PRINTING & ADDITIVE MANUFACTURING 180, 180–89 (2015).