3D printed antennas with conductive filaments

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Additive manufacturing using 3D printing is becoming increasingly popular due to its convenience, ease of use, and low cost. Companies such as Ford, General Electric Aviation, and many others are using 3D printing for rapid prototyping before investing money and time in volume manufacturing. Due to high demand on 3D printers, the number of companies that produce 3D printers grew exponentially in recent years. One major drawback that adversely affects the 3D printing technology today is the limited number of materials that can be used with such printers. Due to this limitation, the use of 3D printing in fabricating devices such as antennas that require both dielectric and metallic parts has been very limited. In particular, several 3D printed antennas studied in the past used standard PLA/ABS in combination with conductive paint to act as the radiating element.

In this study, we present a parametric analysis of 3D printed antennas using conductive filaments and Polyactic acid (PLA) as dielectric materials. To illustrate the effectiveness of full 3D printing, we consider the design, fabrication, and testing of a 5.8 GHz patch antenna and several dielectric resonator antennas (DRAs). These antennas utilizes commercially available conductive PLA filament (BlackMagic ™) based on graphene as the material for radiating element and ground plane placed on a PLA substrates. We studied the effect of tool path and layer resolution on the substrate permittivity and conductivity. We also compared these antennas in terms of return loss, gain and radiation efficiency with their metal counterparts constructed using FR4.