

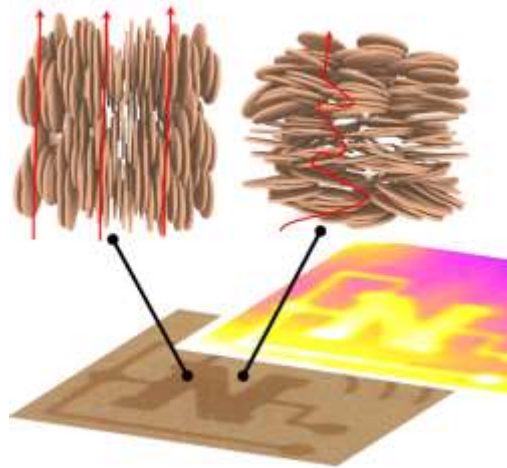
## BEYOND INTUITIVE MICROSTRUCTURES FOR 3D PRINTED COMPOSITES

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3D printed composites marry the worlds of lightweight and tough composite materials with the detailed and programmable geometries of 3D printing. This combination gives rise to a new class of interesting grand challenges to deliver on the net promise of the field. A summary of the current state of 3D printed composites will be provided with a focus on stereolithography (SLA) printing of filled resins that offers high resolution and speed. SLA printing of ceramic filled resins presents many challenges include dispersion issues, poor light penetration, particle alignment, and viscosity handling. Here we offer routes to SLA print resin systems with doped ceramics to exploit magnetic fields to induce programmable alignment within every voxel of a printed 3D part. We offer a vision for implementing numerical simulations of anticipated loads to understand expected internal stress states that inform our design of optimum microstructures within printed composite parts. In addition to optimizing mechanics, we have investigated tuning conduction pathways within 3D printed thermally conductive dielectric parts that have application in the realm of radiofrequency (RF) electronics. Finally, we have found surprising mechanical enhancements through the use of non-intuitive microstructures that can't be simply predicted through finite element analysis of parts under expected loads. These new classes of reinforcing microstructures improve the toughness of printed composites significantly beyond the conventional wisdom for "optimal" microstructure designs.



*Figure 1 – High power density electronics used in modern cellular devices and radio-frequency (RF) electronics generate tremendous localized thermal energy. Here, new magnetovibrational manufacturing routes are investigated to produce a unique class of printable dielectric composites with high thermal conductivity.*