

Periodically microstructured composite films made by electric- and magnetic-directed colloidal assembly

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Living organisms combine soft and hard components to fabricate composite materials with outstanding mechanical properties[1]. The optimum design and assembly of the anisotropic components reinforce the material in specific directions against multidirectional external loads[2]. Although nature does it quite readily, it is still a challenge for material scientists to control the orientation and position of the colloidal components in a matrix. Here, we use external electric and magnetic fields to achieve positional[3] and orientational[4] control over colloid-polymer composites to fabricate mechanically robust materials to capture some of the essential features of natural systems. We first investigated the assembly of spherical micron-sized colloids using dielectrophoresis, as these particles provided an easily accessible and instructive length scale for performing initial experiments. We used dielectrophoresis for spatial control of reinforcing anisotropic components and magnetic fields to provide control over the orientation of these reinforcing constituents. The obtained composites with different orientational and spatial reinforcement showed enhanced mechanical properties, such as wear resistance, which exhibits similarities to tooth enamel.

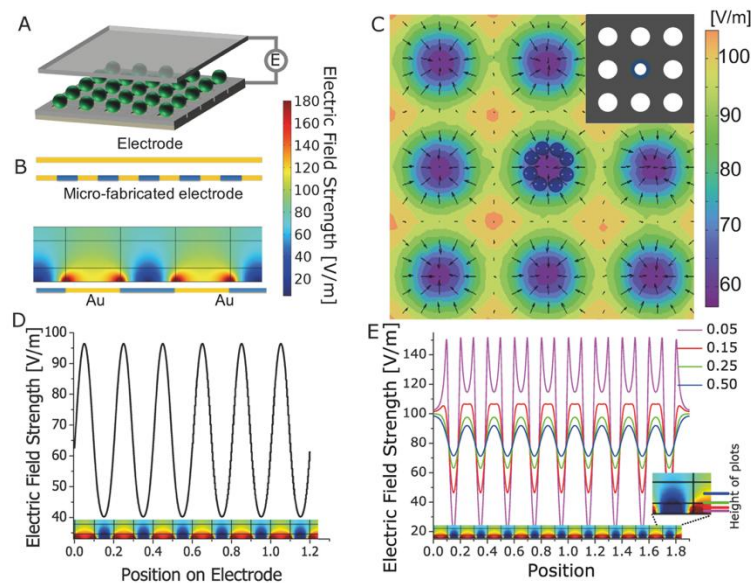


Fig. 1: Sample cell design and electric field strength simulations over the microfabricated electrodes.

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