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Bioinspired Self-Healing Materials[1]

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Synthetic materials are designed to satisfy only one or two functions, but biologically produced ones are multifunctional and have properties (e.g., self-replicating, self-healing) that have yet to be introduced into man-made materials. The objective of this lecture will be to provide an understanding of the important processes for controlling materials properties through nano- and microstructural design and processing with the goal of attaining multifunctionality. A case study will be on the possibility of producing structural materials with self-healing characteristics. In an effort to mimic self-repair functions of living systems, we have been working with self-assembling complex fluids that respond to fields generated by the defects and deposit materials at the site of the defect. Presently, the techniques are limited to certain materials systems as coatings or thin films. We partially mimic the process of blood clotting as a process of colloidal aggregation at a defect site. We show that under the influence of an electrical field, colloidal particles detect a defect and aggregate at the defect site to form a protective layer. The basis of this process is the electrohdrodynamic flow generated by the inhomogeneities. We then make this a permanent protective layer through the electrodeposition of a metal binder in the interstitials of the colloidal aggregate.

[1]Functional Ceramics