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Pradeep K Rohatgi

University of Wisconsin-Milwaukee, USA

Development of self-healing metallic materials and composites

Self-healing materials are inspired from natural biological materials that they can heal themselves when injured or bleed. All complex biological organisms have the ability to repair minor damage. Incorporating the self-repair function into inorganic systems is seeing growing interest of materials scientists. Most recent studies were concentrated on polymers and ceramics because it is easier to synthesize them than metallic materials. It can be classified the self-healing materials into two titles: Autonomous self-healing materials and non-autonomous self-healing materials. Grain boundary migration, self-healing of nano-voids at the nanoscale repairing can be evaluated as autonomous self-healing. Non-autonomous self-healing is required an external driving force such as heating. Most recent studies about the self-healing metals and metal matrix composites are non-autonomous healing. Most of the studies were performed on the aluminum alloy, zinc alloy and Sn-Bi alloys about the self-healing metallic materials. Self-healing metals and metal matrix composites can be categorized by shape Memory Alloy (SMA) based healing, microencapsulation based healing and precipitation healing. An approach to obtaining self-healing castings is made by incorporating shape memory alloy (SMA) reinforcements in a cast matrix. Another proposed mechanism is to incorporate a low melting alloy within hollow microcapsules that are embedded in a high melting alloy. An advancing crack breaks the microcapsule, allowing the low melting alloy to be liquefied and flow into the crack. Self-repairing capabilities can also be imparted to metal castings by aging precipitation during casting the alloy which provides closure of voids making stronger materials preventing the formation of initial cracks. Self-healing metallic materials are very promising for future. But currently, it has several constraints for practical application. It has needed developing new self-healing agents or mechanisms to resist high temperature. Researches are continuously improving self-healing metallic materials in order to use this material in near future.

Biography

Pradeep K Rohatgi is a Professor of Materials Engineering and Director of the Center for Composites at the University of Wisconsin-Milwaukee, USA. He is pioneer in the field of composite materials, particularly metal matrix composites. He has coauthored 12 books and over 400 scientific papers. He has 20 US patents and has received numerous awards for excellence in research. He has received numerous awards for excellence in research and has been elected to fellowships of several organizations including TMS, ASM, ASME, SAE, TWAS, SME, AAAS, MRS. His initial research on cast metal composites has been listed as a major landmark in the 11000 year history of metal casting and TMS has organized an honorary symposium to honor his contribution to metal matrix composites. Recently, he has extended his work to make matrix nano composites, syntactic foams, self-lubricating and self-healing metal matrix composite castings.

prohatgi@uwm.edu

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