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Smart materials: A quantum jump in technological advancement

Whether the extension of Le Chatelier's principle applies to human being and materials? It does apply to human being and hence it ranks right at the top in the hierarchy of smartness/intelligence. The human being can process data, convert into information, develop knowledge, gains wisdom and applies it. Can it be engineered to develop smart/intelligent materials so that it responds to external stimulus and changes its response with the help of change in bonding, crystal structure and microstructure? There are certain materials which are inherent smart/intelligent, whereas there are materials need to be induced to generate smartness/intelligence. The former group of materials can be coined as inherent smart materials whereas the latter can be called as induced smart materials. For example, structural smartness behavior under stress can be induced on monoclinic zirconia through partial stabilization with appropriate amount of Y_2O_3 dopant whereas functional smartness can be induced to conduct oxygen ions with the same Y_2O_3 dopant at different proportion. Again, the increase in strength with increasing temperature for certain class of materials like dense Al_2TiO_5, SiC ceramics can be the example of inherent smart ceramics. In sintered Al_2TiO_5 such behavior arises due to the presence of micro-fissures. The micro-fissures form due to thermal hysteresis loop during heating and cooling because of thermal expansion anisotropy in its pseudobrookite crystal structure. Likewise, self-healing materials/composites, self-cleaning glass are the examples of inherent smart materials. In case of functional materials, usually sensors are induced smart materials whereas transducers are inherent smart materials. The presentation will be dealt with many examples of smart materials along with scientific explanation and related applications. This new class of smart materials is believed to contribute quantum jump in human comfort and happiness as well as in economic progress.

References

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2. Mandal, et al. (2015) Mechanical properties of in situ grown rare earth hexaaluminate and yttrium aluminium garnet composites. *Materials Letters;* 145: 321-323.

Biography

Santanu Mandal had joined Carborundum Universal Limited (CUMI) right after accomplishment of PhD at CSIR-CG&CRI in 2001. He did his graduation in Chemical Technology with specialization in Ceramic Engineering and MTech in Ceramic Engineering from University of Calcutta. He has been working in R&D and Technology function at various capacity and presently leading a fine young team of research and development (DSIR approved IRD Unit) of Carborundum Universal Limited. Recently, he is also leading the Technology and R&D of Wendt (India) Limited. He is the recipient of Chairman's Product Innovation Award in three CUFEST. He has published 34 papers in international/national journal and conference proceedings and granted/filed 18 patents in India. He has also been honored with Pavan Nagpal Memorial Award by Indian Ceramic Society, Karnataka Chapter in 2018.

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