

## **Multifunction Integrated Nanocomposites and Their Industrial Applications**

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It is now well understood that the nano and nanocomposite concept is very promising to significantly improve mechanical and thermal properties of structural ceramics. Concentrated researches have found that the nanocomposite concept play important roles not only in structural ceramics but also in various kinds of functional ceramics such as electronic, magnetic and optical ceramic materials. Based on these informations, an attempt was made to develop the multi functional ceramic materials, and various kinds of multi functional ceramic materials were successfully developed, which showed the improved strength and toughness together with new function such as machinability like metals, electrical conductivity and stress and/or fracture sensing function. And some of them were already industrialized in last 5 years. Another important finding in the nanocomposite research was that its concept was also applicable for metal and polymer materials, and new materials successfully developed: for example, a polymer based nanocomposite with a new sensing function like human's finger tip which was already industrialized as a special sensor of intelligent robot named as AIBO and as a material for PC pens. Research on a new material, named as "intermaterial", was also made in Osaka University in the last 7 years. The intermaterials are so called multi functional materials, in which inorganic, organic and metal materials are composed or fused in the nano, molecular and atom level, depending on the structure and properties required, and various new materials were successfully developed. In the presentation, the nanocomposite concept developed 1985; the processing and the structure and property revolution by this concept will be first reviewed briefly. And then we will discuss various suggestions for developing multi functional materials, which were obtained from the nanocomposite researches, and new materials design map on the multi functional ceramic materials will be introduced. Some of newly developed multifunctional ceramic based nanocomposites and their micro/nanostructure-property relationship will be presented, with their industrial applications. Finally, our new materials design concept on molecular/cluster/lattice level composites and some results on them will be presented and discussed.