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Opinion

A Study of Microcapsule Self-Healing Materials

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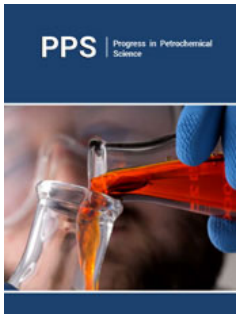

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As a new kind of intelligent material, microcapsule self-healing composite provides a feasible method for repairing microcracks in multiple matrix materials. Nevertheless, microcapsule self-healing system still face the limitation of widespread research and application in the aspects of property performances. In this work, we mainly describe the background, basic properties, and challenges of the self-healing materials based on microcapsules. Recently, self-healing polymer composites have been extensively focused [1]. Compared with traditional polymer materials, self-healing polymers can restore the original properties of materials without significant artificial intervention [2,3]. With the rapid development of microcapsule technology, microcapsule self-healing material has gradually gained attention in the repair of microcracks to polymer composites and become a crucial spot in the field of new materials [4].

The repair principle is that the microcapsules containing the healing agents rupture when the damage occurs in the substrate, and the released healing agents reaches the microcracks and triggers a polymerization reaction to repair the cracks under a certain mechanism of action. The microcapsule self-repair system could achieve efficient healing of damage, prolong the service life of materials, reduce maintenance costs, and improve stability [5]. To achieve future widespread application, the ideal microcapsule self-healing materials should meet the following characteristics. (a) The microcapsules maintain long-term stability during service period without chemical reaction, until the microcapsule ruptures. (b) The healing agents have appropriate fluidity and reaction rate, and the shrinkage of healing agents is small after polymerization, forming the polymer with adhesion ability and mechanical properties. (c) Stable microcapsule shells are not permeable and will not react with the healing agents or matrix material. (d) The shell of microcapsule is strong enough for processing and could respond immediately to microcracks. The self-healing ability of microcapsules to external damage has great potential for polymeric materials, but there still exists potential challenges. (a) The presence of microcapsules in polymeric materials would not destroy the properties and functions of the original material. (b) Microcapsule self-healing materials are difficult to achieve repeated healing. (c) Realize truly automatic repair of materials without any artificial intervention. (d) Lack of accurate evaluation of the self-healing properties of polymer materials, including detection of internal damage, and reporting of damage locations. In summary, the research on microcapsule self-healing materials has far-reaching significance for improving the reliability and stability of composite materials. Therefore, it is necessary to vigorously accelerate the research work on microcapsule self-healing materials, and then design complete and efficient experimental procedures, to produce microcapsule self-healing materials with positive performance, so as to improve material reliability, reduce maintenance cost.

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