2D material- enhanced superhydrophobic protective coating

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Abstract

The propose of this work is to develop superhydrophobic coatings by using 2D materials. The objective was achieved by developing hybrid coatings through sol-gel process and functionalization reaction. The role of hybrid molecules was particularly important for enhancing the hydrophobic properties of the hybrid coatings. The approach of current research is to develop a low temperature sol-gel coating process that gives better performance on metal surface. In this work two hybrid coatings were synthesized by two different mechanisms. 3-trimethoxy silyl propyl diethylene triamine and 3-trimethoxysilyl propyl methacrylate (TMSPM) precursors were mixed by stirring under nitrogen environment at 50 °C for 24 hours to formulate TSP-TM @HYBRID coating. The TSP-GLY @HYBRID coating was synthesized by ring opening polymerization process using 3-trimethoxy silyl propyl diethylene triamine and 3-glycidoxypropyltrimethoxysilane (GPTMS) silane precursors. In the second step 2D material (graphene) was synthesized from graphite flasks and thermal reduction process. The functionalization of 2D material was done by using amine (APTES) sol-gel precursors. In the final step TSP-TM @HYBRID coating and TSP-GLY @HYBRID coating were mixed with functionalized graphene to synthesize 2D material-based hybrid coating materials. The novelty of this work was the development of hybrid coatings by two different mechanisms and role of silane coupling agent. In this work, we explore the possibility of developing hybrid materials using 3-trimethoxy silyl propyl diethylene triamine, 3-glycidoxypropyltrimethoxysilane (GPTMS) ,3-trimethoxysilyl propyl methacrylate (TMSPM) silane coupling agent and functionalized graphene.

References

[1] Gao, Y. *et al.* Organic− Inorganic Hybrid from Ionomer via Sol− Gel Reaction. *Chemistry of materials* **13**, 3644-3652 (2001).

[2] Blas, F. *et al.* Processing thermal barrier coatings via sol-gel route: Crack network control and durability. *Surface and Coatings Technology* **334**, 71-77 (2018).

[3] Tiwari, A., Zhu, J. & Hihara, L. H. The development of low-temperature hardening silicone ceramer coatings for the corrosion protection of metals. *Surface and Coatings Technology* **202**, 4620-4635 (2008.

Figures

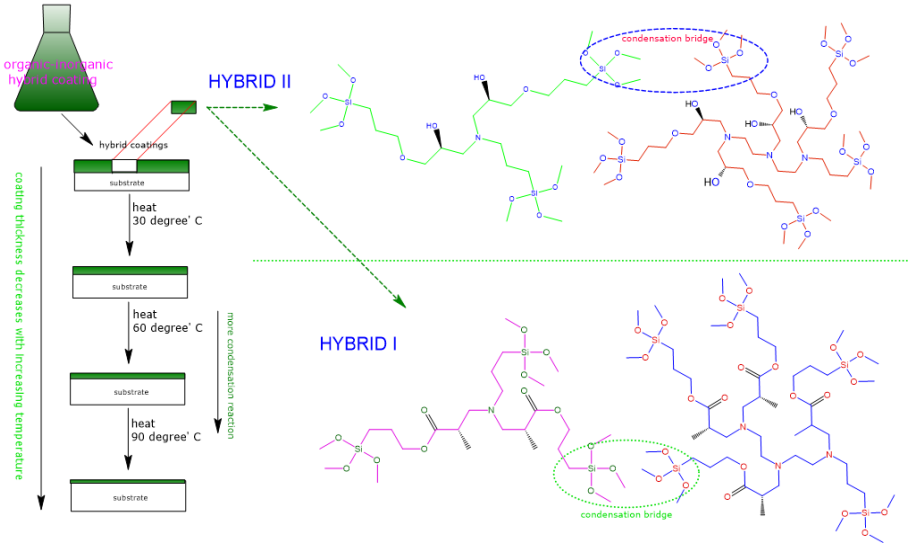

Figure 1: Synthesis procedure of HYBRID I and HYBRID II from siloxane precursors and 2D materials