Chapter 12
Sol-Gel-Based Multifunctional Superhydrophobic Coatings and Its Tribological Properties:

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ABSTRACT

This chapter summarizes key issues in the fields of multifunctional superhydrophobic coatings with an analysis of their tribological properties. In this respect, the authors explore a simple sol-gel process strategy and tribological properties controlled through a reaction of ORMOSIL-based polymers that generate multifunctional minimum free energy structures of micro- to nano-scale siloxane chains. Different compositions and dimensions of solid materials (contact angle = 150° and sliding angle = 10°) can be superhydrophobic fabricated through various deposition methods. The complete waterproof layering has been demonstrated to have excellent cost, scalability, and especially the ability to encapsulate other functional groups. The perspectives have established many significant functionalities with better tribological properties for the next generation of smart multifunctional superhydrophobic coatings.

INTRODUCTION AND BACKGROUND OF SUPERHYDROPHOBIC COATINGS

Research on the superhydrophobic surface(SHS) has been extensively developed from fundamental principles of functional investigation in recent years. In the field of practical applications such as self-cleaning, resistance to corrosion, drag reduction, antifreeze, and oil-water separation, multifunctional superhydrophobic surface applications have tremendous potential(S. A. Mahadik, Pedraza, & Mahadik,

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2017). For SHS the existence of a micro/nanostructure is crucial. Overall, an appropriatearrangement of surface roughness witha low-energy surface produces artificial SHS. Two approaches are often used to create a superhydrophobic surface. The first technique involves generating rough surfaces, followed by covering materials with low surface energy(Satish. A. Mahadik et al., 2016). The second method is to restructure the hydrophobic material surface(S. A. Mahadik et al., 2016). Superhydrophobic coatings like smart coatings have become multifunctional, efficient, and versatile with the recent advances in coating technology and have also attracted global research interest.

Complex multi-scale structures with nanostructures on top of micro-structures efficiently enhance the texture hierarchically and decrease the interface between texture and liquid. Naturally, the results guide the creation of artificial SHSs and the design of surfaces with controlled wettability. Despite different preparation procedures, the commercialization of superhydrophobicity has been seriously affected due to their low tribologicaland chemical stability, as well as the fragility of their dual-scale roughness characteristics. There is consequently great emphasis on the mechanical strength and endurance of multifunctional superhydrophobic coatings in recent studies(S. A. Mahadik et al., 2013). Superhydrophobic coatings like smart coatings have become multifunctional, efficient, and versatile with the recent advances in coating technology and have also attracted research interest(S. A. Mahadik et al., 2012b). Due to their performance, such coatings may be applicable in all possible domestic areas. Superhydrophobic coatings are suitable for diverse applications in various fields, such as automotive windshields and photovoltaic solar panels for self-cleaning purposes in the solar power sector, marine infrastructure, aircraft, and naval ships for an anti-corrosion, and anti-icing purposes, etc.

MAIN FOCUS OF THE CHAPTER

The chapter focuses on the multifunctional and tribological properties of organically modified silica (ORMOSIL) based superhydrophobic coatings that expand every year. However, there are few relevant studies from the current literature on multifunctional superhydrophobic coatings with tribological properties in some fields. This chapter summarizes a multifunctional superhydrophobic coating with tribological performance and functionalities like self-cleaning, transparency, anti-icing, anti-corrosion, and some other functionalities.

METHODS FOR PRODUCING SUPERHYDROPHOBIC COATINGS.

Superhydrophobic surfaces fabrication strategies can be classified and shown in **figure 1**.