Lowering the surface energy and boosting the wear resistance and flexibility of transparent omniphobic POSS coatings

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Transparent coatings that repel high- and low-surface tension contaminants are desirable for applications that include self-cleaning windows, anti-fouling ship hulls, anti-icing airplane wings, and anti-fingerprint touchscreens. For application on the protective encapsulating polymer film of the touchscreen of a foldable smartphone, the coating also needs to be highly wear-resistant (hard) and flexible. Currently used coatings are not wear resistant enough and there have been many complaints and reports detailing issues with the durability of foldable screens. This dilemma is easy to understand because hardness and flexibility have been mutually exclusive up until recently. To address this challenge, our group has recently photocured 3-glycidyloxypropyl polyhedral oligomeric silsesquioxane (GPOSS) grafted with the anti-smudge agent poly(dimethyl siloxane) to yield the first example of a hard yet flexible anti-smudge coating.[1] This coating can resists abrasion even by steel wool for tens of times without loss of its anti-smudge properties.

My PhD research has been aimed at further improving the de-wetting properties, hardness, and flexibility of POSS-based coatings. To effectively repel fingerprint residue, a low surface energy is required that can only be achieved by the use of fluorinated reagents. I will discuss the lowering of the surface energy of GPOSS coatings after the incorporation of perfluorinated reagents.[2] I will also discuss using POSS that contains two different types of polymerizable groups around the POSS core to achieve a higher hardness and greater wear resistance than what was achieved by GPOSS, which contains only polymerizable glycidyl groups.[3] Lastly, I will describe the work I have done to reduce the critical bending radius to an unprecedented low value of < 1 mm for hard yet flexible omniphobic coatings.[4]

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2. Bender, D. N.; Zhang, K.; Wang, J.; Liu, G., Hard yet Flexible Transparent Omniphobic GPOSS Coatings Modified with Perfluorinated Agents. *ACS Appl. Mater. Interfaces* **2021**, *13*, 10467-10479.
3. Bender, D. N.; Hait, S.; Lichtenhan, J. D.; Liu, G., UV Curing Behavior of Five Heteroleptic POSS Bearing Methacrylate and Glycidyl Groups and Evaluation of Their Potential for Hard Yet Flexible Coatings. *ACS Appl. Polym. Mater.* **2022**, *4*, 1878-1889.
4. Bender, D. N. and Liu, G., Endowment of Omniphobicity and Exceptional Bendability to a POSS Coating with High Hardness and Wear Resistance. **2022**, submitted.