TRANSPARENT HYDROPHOBIC MXENE: DE-ICING AND SELF-CLEANING COATINGS FOR SOLAR PANELS

Ezrah Mariam, Lois Damptey, Ajay Kumar, Irwing Ramirez, Nicholas Power, Ravi Silva, Satheesh Krishnamurthy
Advanced Technology Institute, University of Surrey, Guildford, United Kingdom, GU2 7XH
e.mariam@surrey.ac.uk

Photovoltaic (PV) devices play a vital role in addressing global sustainability issues like climate change, as a renewable source of energy which can help achieve net zero carbon emissions. However, soiling of the PV panel surface restricts solar radiation from reaching the solar cells leading to irregular generation of output power and hence decreasing their efficiency significantly. This poses environmental and sustainability challenges due to output losses and high usage of clean water required for their maintenance. Self-cleaning coatings provide an automated alternative for cleaning glass surfaces of solar panels while reducing abrasion damage as well as expenditure on workforce and water usage.

Current self-cleaning coatings have certain drawbacks like reflectivity and durability issues [1]. In our work, we propose the study of transparent and de-icing self-cleaning coatings which can assist in maintaining the effectiveness and reliability of PV panels. 2D materials like MXenes are studied for their extraordinary photothermal properties for inducing an anti/de-icing effect in the self-cleaning coatings [2][3][4]. MXenes are also known for their good mechanical durability making them an efficient candidate for coatings [5][6]. A comparison of HF etching and molten salt synthesis method is done to study the surface functionalities and their effect on the photothermal property of MXene. A non-thermal atmospheric pressure plasma jet printing of MXene to glass has been used and tuned for its hydrophobicity, thickness, and durability. Last but not the least, methods to promote environmental friendliness and reduce the toxicity and risks of the coatings are explored.

Various characterisation techniques are used to analyse the coating properties. Contact angle measurements show that after the Ti_2C MXene coating on glass, the hydrophobicity increased significantly with the highest average contact angle of 138.91°. Furthermore, MXenes show interesting photothermal properties upon plasma printing onto glass slides. A de-icing and self-cleaning coating with high photothermal temperature which goes up to 85°C was achieved. The structural and morphological characterisation techniques were used to confirm the etching of MAX phase and subsequent formation of MXene. The electronic properties were studied using monochromatic XPS and it was found that chemical bond formations and functionalities play a key role in defining the surface and photothermal properties of MXene. Further investigation and analysis are in progress to understand the mechanisms of these materials. Alternative greener methods to synthesise MXenes, including molten salt synthesis using $CuCl_2$, are explored.

References

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