High-quality MXene inks for energy storage

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Two-dimensional transition metal carbides and nitrides, so-called MXenes, have quickly attracted intensive attention and have found quite promising applications in various fields, such as water desalination, energy storage, catalysis, etc. These cutting-edge applications require the production of high quality MXene nanosheets with a high concentration. However, this has proven to be quite challenging.

Here in this talk, I will describe the synthesis of high-quality MXene nanosheets, followed by the oxidation stability mechanism of MXene aqueous solutions, which is quite important for the long shelf life and is the prerequisite for the industrial application of MXenes.[1] Then I will show the importance of the viscous inks in the efficient fabrication of high-performance transparent conductive films/coatings,[2] scalable production of micro-supercapacitors assisted by the additive-manufacturing techniques (Figure 1).[3] The ink viscous nature also allows the MXene nanosheets to perform as a conductive binder for Si nanoparticles, resulting in high mass-loading MXene/Si anodes with an ultrahigh areal capacity (Figure 2), which is 5 times higher than that of commercial anode.[4] In addition, I will show the formulation of organic MXene inks for scalable additive-free printing of energy storage devices, as well as the formulation of composite ink for Lithium-sulfur batteries (Figure 3).[5]

We therefore believe the high-quality MXene inks hold a bright future for the next-generation energy storage devices at a low cost.

References

[1] C. Zhang, et al., Chemistry of Materials, *2017. 29 (11), 4848-4856*

[2] C. Zhang, et al., Advanced Materials, 2017, 29, 1702678

[3] C. Zhang, et al., Advanced Functional Materials, 2018, 28, 1705506

[4] C. Zhang, et al., Nature Communications, 2019, 10, 849

[5] C. Zhang, et al., Advanced Science, 2018, 5, 1800502

Figures

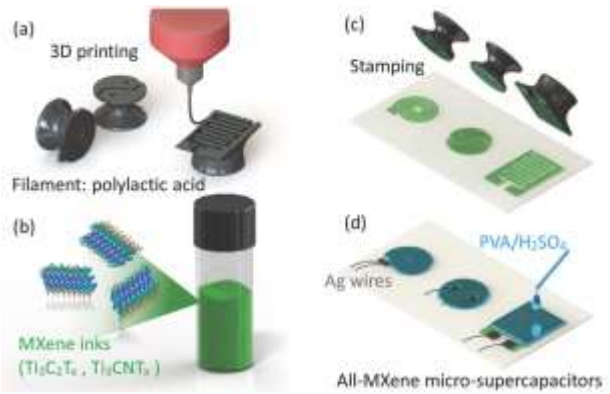

Figure 1: Production of micro-supercapacitors by stamping MXene viscous inks

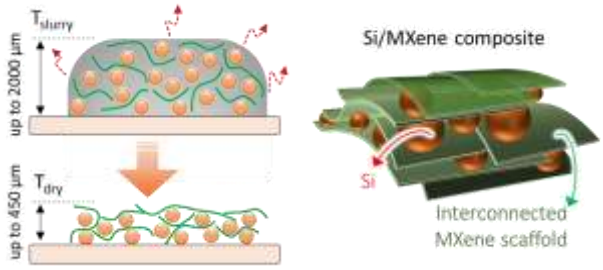

Figure 2: Production of MXene-Si composite slurry for fabricating high mass loading Si anode.

Figure 3: Production of MXene-S composite inks.