Surface Treatment of Two-Dimensional $Ti_3C_2T_x$ Using Radio-Frequency Remote Plasma System

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Two-dimensional transition metal carbide and/or nitride (MXene) have attracted much attentiondue to its unique structure and outstanding physical properties such as highelectrical conductivity, large surface area and various chemicalfunctionalities. It realizes the potential for future applications including energy storage,electronics, gas or biological sensors and membranes.[1] The MXenes are synthesized through selectiveetching of A-elements from MAX phases by wet etchingprocess. However, the high sensitive surface properties of MXene give rise toformation of surface terminations (-O, -OH, and -F) during etchingprocesswhich have been predicted to be directly responsible for various materialproperties.[2,3] Furthermore, it causes toaccelerate the oxidation of MXenes in not only operating environment of variousMXene-based devices but also general environment. Therefore, the tuning ofsurface terminations and reduction of MXenes is necessary to realize the future applications.

We demonstrate the surface treatment of MXene using RF remote plasma system. Two-dimensional titanium carbide ($Ti_3C_2T_x$)was prepared by selective Al interlayer etching of Ti_3AlC_2using lithium fluoride (LiF) and hydrochloric acid. The $Ti_3C_2T_x$was exposure to H_2 plasma using a RF remote plasma system. In thissystem, the plasma generator and the substrate holder are vertically arranged. Thesample was located on grounded substrate holder to minimize the effect of ionbombardment. The H_2 plasma was ignited to perform the surface treatmentof $Ti_3C_2T_x$. The effect of plasma surfacetreatment on the change of surface terminations and electrical properties of $Ti_3C_2T_x$was investigated by adjusting the plasma power, process pressure and exposure time.

Reference

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