Photoluminescent Ti_3C_2 MXene Quantum Dots for Multicolor Cellular Imaging

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A new class of two-dimensional (2D) early-transition-metal carbides (MXenes) have received significant interest for energy storage, environmental, and biomedical applications due to their superior properties (2400 S/cm for electrical conductivity, 410 $mAhg^{-1}$ at 1 C for lithium-ion batteries), but MXenes generally exhibit a low photoluminescence response in aqueous solution, which limits their direct biological and optical applications. Herein, for the first time, we report the development of a facile hydrothermal method for the fabrication of photoluminescent Ti_3C_2 MXene quantum dots (MQDs). [1] The average sizes of the MQDs can be tailored in the range 2.9–6.2 nm by employing different reaction temperatures. Interestingly, the MQDs obtained at 100 °C retain the MXene structure, whereas MQDs fabricated at 120 °C possess a Ti_3C_2 core and a Ti–O surface. When the reaction temperature increases to 150 °C, amorphous carbon dots with small amounts of Ti atoms were obtained. The as-prepared MQDs show excitation-dependent photoluminescence spectra with quantum yields of up to ~10% due to strong quantum confinement. The applications of MQDs as both biocompatible multicolor cellular imaging and zinc ion detection were demonstrated. Our work provides a facile method for the fabrication of MQDs and may greatly extend the applications of MXene-based materials.

1) Xue, Q., et al. (2017). "Photoluminescent Ti_3C_2 MXene Quantum Dots for Multicolor Cellular Imaging." Adv. Mater. DOI: 10.1002/adma.201604847