Structural Manipulation of Carbon Nitride for Electrochemiluminescent Sensors

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Abstract

Chemical structures of two-dimensional (2D) nanosheet can effectively control the properties thus guiding their applications. However, carbon nitride nanosheets (CNNS) with tunable chemical structures and sizes had been rarely explored, thus impeding the boost of performances. Herein, we demonstrate that CNNS with tunable chemical structures can be obtained by liquid-exfoliation of facile accessible bulk carbon nitride with different polymerization degree. In comparison with previous methods, the proposed route was green, not requiring any additives, toxic solvents or preintercalation steps. Interestingly, the ECL of as-prepared CNNS was significantly modulated, and exhibited unusual changes in quenching and enhancement upon adding different metal-ions. Such advantage was further applied to construct sensors for multiple metal-ions without any labeling and masking reagents. The detection limit estimated at a signal-to-noise of 3, of Cu2+, Ni2+, and Cd2+ were 250 nM, 1 nM and 20 nM, respectively, which was 2_˜340 times lower than the maximum level in drinking water permitted by WHO. It was further revealed that the strong ECL quenching effect was due to the inner filter effect/electron transfer process and the enhancement was due to the catalytic effect. It would open a vista to explore 2D carbon-rich materials for a wide range of applications such as sensing with enhanced performances based on new mechanism.

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