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Effects of Nitrogen Doping on Surface-enhanced Raman Scattering (SERS) Performance of Bicrystalline TiO_2 Nanofibres

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Abstract In this work, we successfully synthesized bicrystalline anatase/TiO_2(B) nanofibre and used it as active substrate for surface-enhanced Raman scattering (SERS) applications. The bicrystalline structured TiO_2 substrates provide additional charge transfer across the anatase-TiO_2(B) interface and thus enhanced activity compared to the pure single crystalline phase. With an effort to further increase the sensitivity of SERS, nitrogen element was doped into bicrystalline anatase/TiO_2(B) nanofibres (N-TiO_2) and higher SERS enhancement was achieved. The nitrogen content was controlled by tuning the calcination temperature of titanate precursor at 500, 600 and 700 ^oC, respectively. The sample calcined at 600 ^oC (NT600) acquires the highest percentage of nitrogen element due to the its open pore structure that facilitates the diffusion of nitrogen during calcination. Raman intensity depends on the amount of nitrogen doping, thus NT600 exhibited the best SERS activity. The doped nitrogen in TiO_2 facilitates the charge transfer between TiO_2 and probing molecules and thus suppress the electron-hole recombination. This work provides a new perspective on the design of efficient TiO_2 SERS active substrate and is expected to be valuable for adsorbate detection on semiconductor surface.

Keywords: bicrystalline; anatase/TiO_2(B); nitrogen-doped TiO_2; SERS; charge-transfer

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