Adsorption of selenium (Se^{4+}) ions pollution by pure rutile titanium dioxide nanosheets electrochemically synthesized

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ABSTRACT

In this work, pure rutile titanium dioxide (TiO$_2$) nanosheets are synthesized by the electrochemical deposition method using a rectangular titanium plate (4 cm × 2 cm × 0.1 cm) as both cathode and anode with a current density of 9.2×10^{-3} mA/cm^2 for 3 h. The rutile TiO$_2$ nanosheets are investigated by both scanning electron microscopy and transmission electron microscopy measurements, and their crystal structure is obtained using the X-ray diffraction technique. The Brunauer–Emmett–Teller analysis was shown the surface area of the rutile phase was 52 m^2/g. The electrochemical synthesized rutile TiO$_2$ nanosheets behave as an attractive adsorbent for Se^{4+} ions from their aqueous solutions. We examined the impact of contact time, pH, adsorbent mass, temperature and initial concentration of Se^{4+} ions. The Se^{4+} ions isotherm adsorption showed a good fit with Freundlich isotherm and Langmuir models. The thermodynamic study was done to calculate the ΔS, ΔH and ΔG parameters, which obtained 7.39 kJ/mol, 39.32 J/mol K, and –4.32 kJ/mol, respectively. Moreover, the kinetic study showed the adsorption behaved as pseudo-second-order.

Keywords: Titanium dioxide; TiO$_2$; Rutile phase; Adsorption; Selenium; Electrochemical method

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