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Effective Uranium (VI) Sorption from Alkaline Solutions Using Bi-Functionalized Silica-Coated Magnetic Nanoparticles

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High temperature gas reactor is one of generation IV reactors that can adapt the future energy market, of which the preparation of fuel elements will produce a large amount of radioactive wastewater with uranium and high-level ammonia. Sorption treatment is one of the most important method to recover uranium from wastewater. However, there are few report on uranium sorbent that can directly be applied in wastewater with ammonia. Therefore, the development of a sorbent that can recover uranium in basic environment will greatly decrease the cost of fuel element production and the risk of radioactive pollution. In this work, ammonium-phosphonate-bifunctionalized silica-coated magnetic nanoparticles has been developed for effective sorption of uranium from alkaline media, which are not only advantaged in the uranium separation from liquid phase, but also with satisfactory adsorption rate, amount and reusability. The as-prepared sorbent is found to show a maximum uranium sorption capacity of 70.7 mg/g and a fast equilibrium time of 2 h at pH 9.5 under room temperature. Compared with the mono-functionalized (phosphonate alone and ammonium alone) particles, the combination of the bi-functionalized groups gives rise to an excellent ability to remove uranium from basic environment. The sorbent can be used as a promising solid phase candidate for highly-efficient removal of uranium from basic solution.

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