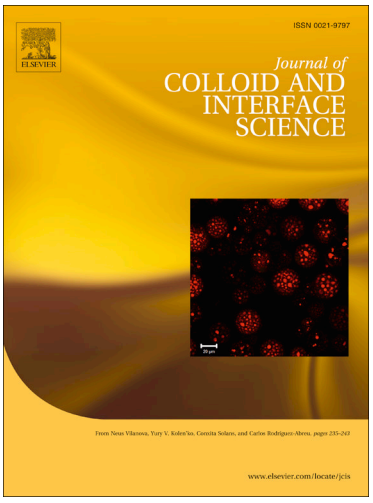

Co-adsorption and sequential adsorption of the co-existence four heavy metal ions and three fluoroquinolones on the functionalized ferromagnetic 3D $NiFe_2O_4$ porous hollow microsphere

Xueyan Liu, Mingyang Liu, Lei Zhang

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Co-adsorption and sequential adsorption of the co-existence four heavy metal ions and three fluoroquinolones on the functionalized ferromagnetic 3D $NiFe_2O_4$ porous hollow microsphere

Xueyan Liu, Mingyang Liu, Lei Zhang*

College of Chemistry, Liaoning University, Shenyang 110036, People's Republic of China

Abstract: Functionalized magnetic microsphere $NiFe_2O_4$ (MS-$NiFe_2O_4$) with a 3D hierarchical porous hollow structure was fabricated using urea as the modifier and soft templates by a simple one-pot solvothermal method. The constructed MS-$NiFe_2O_4$ shows excellent dual functions which can not only undergo simultaneous rapid removal of the co-existence metal ions (Cu^{2+}, Cd^{2+}, Cr^{3+} and Zn^{2+} ions), but also availably adsorb fluoroquinolone (FQs) (ciprofloxacin (CIP), enrofloxacin (ENR) and norfloxacin (NOR)), and is easily recycled using an external magnetic field. The removal efficiency of eight targets could all reach up to 80% within 60 minutes at pH 5. The independent adsorption of single contaminants, the competitive adsorption of multiple heavy metal ions/organic contaminants, the simultaneous and sequential adsorption of the co-existence of inorganic and organic contaminants onto MS-$NiFe_2O_4$ were explored in detail. Competition adsorption occurred between the same type of contaminants. For different types of contaminants, four metal ions did not affect the adsorption of the other three FQs in the sequential and simultaneously adsorption system, and vice versa. The possible adsorption mechanism between targets and MS-$NiFe_2O_4$ was revealed.

***Keywords*:** Functionalized magnetic hollow $NiFe_2O_4$ microsphere; Heavy metal ions; Fluoroquinolone; adsorption

* Corresponding author Tel.: +86 24 62207809; Fax: +86 24 62202380.

E-mail address: zhanglei63@126.com (L. Zhang).