DTPA-FUNCTIONALIZED SILICA-BASED MONOLITHS FOR THE REMOVAL OF TRANSITION AND LANTHANIDE IONS FROM AQUEOUS PHASE

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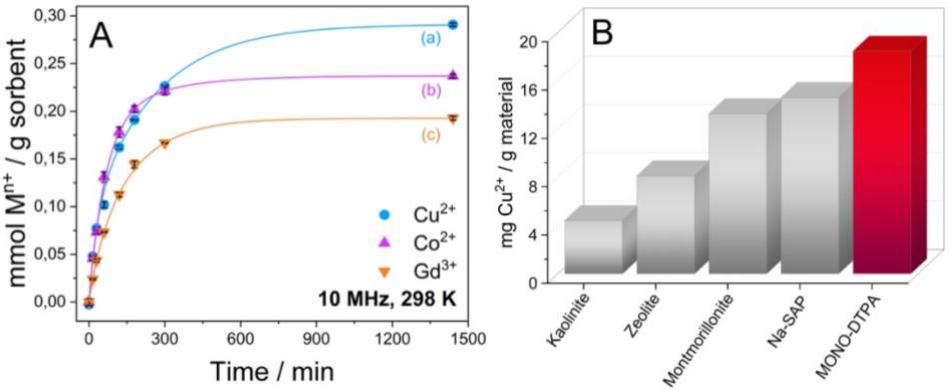
Transition and rare-earth metals are essential raw materials used in a wide range of technological applications; moreover, their consumption is often associated with high production of wastes. Therefore, their recycling and recovery from end-of-life products or metal-contaminated aqueous environments is of considerable importance from a circular economy perspective. In our study, synthetic mesoporous silica monoliths, obtained by sol-gel synthesis[1] and functionalized with chelating groups are used for the recovery of metal ions from aqueous matrices (MONO-DTPA). The monoliths were characterized using a multi-technique approach and were tested in the recovery of paramagnetic Gd^{3+}, Cu^{2+} and Co^{2+} ions from aqueous solutions, using ^{1}H-NMR relaxometry to evaluate their uptake performance in real time and in simple conditions[2]. Detailed information on the kinetics of the capture process was also extrapolated. Finally, the possibility to regenerate the solid sorbents was evaluated. The modified silica monoliths were able to recover an appreciable amount of both di- and trivalent metal ions. The best results were obtained in the case of Cu^{2+} after 24 hours of contact, with a recovered amount of 0.29 mmol/g corresponding to 18.48 mg/g (Fig. 1, A).



The capture performance of MONO-DTPA has been shown to be superior to that of natural or synthetic materials commonly used for metal ion removal (Fig 1, B).

Figure 1: *A) mmol amounts of Cu^{2+}(a), Co^{2+} (b) and Gd^{3+}(c) captured by 1 g of MONO-DTPA overtime; B)* maximum adsorption capacities of Cu^{2+} ions of MONO-DTPA compared to other natural materials.

[1] V. Miglio, C. Zaccone, C. Vittoni, I. Braschi, E. Buscaroli, G. Golemme, L. Marchese and C. Bisio, *Molecules* **2021**, 26, 1316
[2] S. Marchesi, S. Nascimbene, M. Guidotti, C. Bisio and F. Carniato, *Dalton Trans.* **2022**, 51, 4502–4509.