

Post-doctoral position: **Design protocols of selective extraction and separation of lanthanide ions from their mixtures**

Duration 12 months (at least)

Grup de Magnetisme i Molècules Funcionals (GMMF), Barcelone, Spain

The elements of the Lanthanum series and their analogues (rare earths) are considered by the European Union and the USA as critical raw materials. This is because of their exceptional optical and magnetic properties, which confer them a crucial role in a large number of applications of vital economic importance, for example, with the fabrication of electronic devices such as tablets, smart phones or electric vehicle components. Thus, the marked size of these elements in 2020 was over 2.600 million USD. Their economic importance is in contrast to the difficulties associated to their extraction and separation. Due to the large similarity in chemical properties of this group of elements, they normally present themselves in Nature as mixtures and in turn, they are very difficult to separate. The currently existing methods to discriminate and thus, separate them are poorly efficient and thus, very costly, economically as well as environmentally. These are either chemical or physical methods and in both cases they require large amounts of energy, polluting materials and harmful conditions. For all these reasons, it is of great social, economic and environmental interest to access more efficient and feasible methods of extraction and separation of rare earths from their mixtures.

The project PGC2018-098630-B-I00 allowed to engender or improve unprecedented scientific results that could be exploited to satisfy the above mentioned needs. Specifically, a new synthetic method has been discovered for the preparation of heterometallic coordination complexes with two or three metal lanthanide ions with the metal distributions [LnLn'] and [LnLn'Ln], respectively. These compounds are formed from solution mixtures of the Ln and Ln' ions and their molecules are highly selective in terms of the composition and the specific location of the different metal ions in the structure. It is an exceptional process since methods of such high selectivity to obtain heterometallic lanthanide molecules have not been previously described, given the chemical similarity among these metal ions.

With the current project it is intended to exploit this synthetic method to design protocols of selective extraction and separation of lanthanide ions from their mixtures. The purpose is first to demonstrate the capacity to carry out simple separations and subsequently increase progressively the complexity of the systems addressed. During the project, the intention is to design and synthesize extracting ligands with higher solubility in polar solvents (especially water) in order to render the protocols more sustainable. The respective coordination complexes will also be isolated and characterized.

The results from this project will be protected through patents and trade secret procedures, whereas some scientific results shall be published if this does not put at risk the protection of any relevant procedure. An analysis of the market will be performed in order to determine the companies potentially interested in developing or exploiting the new separation procedures, while a process of training the researchers of the team on the transfer and valorization of scientific results will take place.

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