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# Magneto-electrochemical recovery of diluted metals using three-dimensionally structured electrodes

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In a typical metal recovery process, where highly purified metals are obtained from a concentrated electrolyte, usually the cathodic electrodes are planar and can be described mainly as bi-dimensional. This leads to a low space-time yield and low normalized space velocity with an impact on production rates. New requirements of low-energy consumption yet intensive production factories impose the need to adequate electrodes in order to comply. Furthermore, a reduction in the number of steps required to achieve a product would be ideal. This suggests that direct electro-precipitation of metals contained in diluted electrolytes would be in principle a desirable technique to implement. However, the less concentrated the solution, the higher the IR drop becomes, making the process more energy-consuming and current efficiency strongly decays.
Good potential alternatives arise from three-dimensionally designed electrodes in the form of mesh, porous or fluidized beds, for instance, and several examples are well known in literature. Nevertheless, current efficiency can still be a problem in the more diluted electrolytes. Furthermore, the anodic electrode, where the counter reaction takes place, plays also an important role in determining the current efficiency of the overall process. In this case, the liquid-to-gas phase transition implies that the electrodes get a strong gas shield that increases the IR drop. Whereas shifting from bi-dimensional to three-dimensional electrodes could provide an alternative for achieving better performances, it is still far from the expected targets. Therefore alternative or complementary techniques to improve efficiency are required.
It is well known that magnetic fields coupled with electric fields enhance mass transport via de Lorentz and other forces. In this work, the applications and properties of three-dimensional arrays subject to magnetic field interactions are examined and compared with the traditional bi-dimensional electrodes. Various cell configurations and electrolyte are studied for the electrolytic removal of metal ions from diluted solutions containing a complex matrix of base composition Au, including other ions as is the case for solutions obtained from some actual mineral ores. The results are discussed in terms of recovery yield versus cell efficiency.

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