Sustainable production of metallic nanoparticles by olive oil industry waste.

KEYWORDS

- ❑ GREEN-CHEMISTRY
- ❑ CATALYSIS
- ❑ SYNTHESIS
- ❑ NANOPARTICLES
- ❑ POLYPHENOLS

AREA

- ❑ NANOTECHNO-LOGIES & MATERIALS

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Patent for invention.

Co-Ownership
Sapienza Università di Roma 50%, Universitad de Granada 50%.

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Industrial & Commercial Reference
Process and fine chemistry, biomedical, electronic, food, environment protection.

Time to Market
Pilot-scale tests are necessary before its industrialization (TRL 4).

Availability
Research, Development e Experimentation.

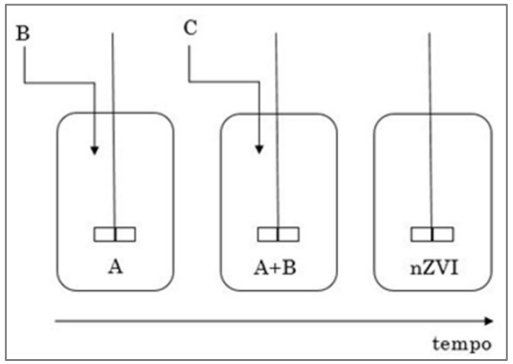

Fig. 1 Procedure for the synthesis of nZVI (nano-iron), where A, B and C are the solutions of metallic precursor, extract and base, respectively.

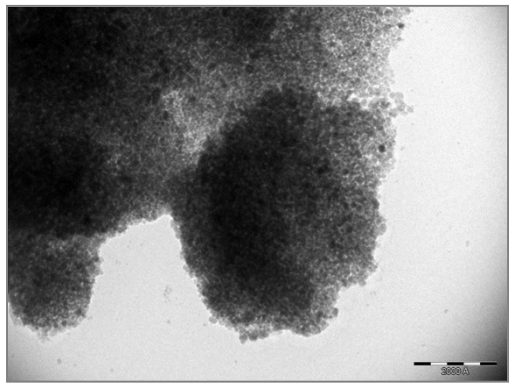

Fig. 2 HR-TEM image of the produced metallic nanoparticles in polyphenolic matrix.

Abstract
The invention is based on the use of a non-toxic reducing agent, at zero cost and easy to obtain, to produce metal nanoparticles, fllowing the principles of "green chemistry" and "circular economy".
The synthesis process involves the use of a metallic precursor, a basic solution for pH correction and a natural extract from the waste of the olive oil industry, obtained by extracting the reducing compounds from the solid waste (pomace, residual pulp, leaves) or liquids (olive mill wastewater, vegetation water, brines) using industrial process waste water as an extraction medium.

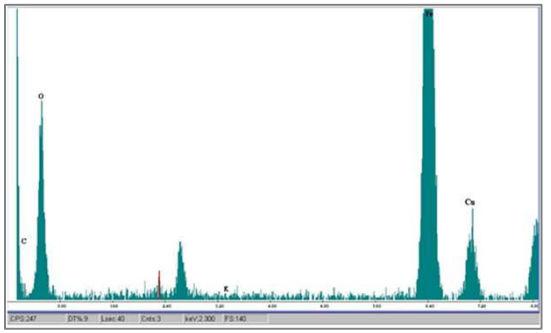

Fig. 3 EDS spectra of produced metallic nanoparticles.

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Sustainable production of metallic nanoparticles by olive oil industry waste.

Technical Description

In a typical synthesis procedure it is necessary to prepare an aqueous solution of a salt of the metal precursor and an aqueous solution of a base. The precursor solution is initially placed in a discontinuous or continuous reactor with mechanical stirring, under conditions of micro-mixing. Micro-mixing conditions homogenizes the reagent species and allows chemical reactions on a molecular scale. The use of inert gases in solution during the synthesis is not necessary, as the nanoparticles produced will be protected by the polyphenolic matrix. It is therefore necessary to add the right amount of extract, previously prepared, for the synthesis. Immediately afterwards it is necessary to increase the pH of the medium in order for the chemical reduction process of the metallic precursor to take place.

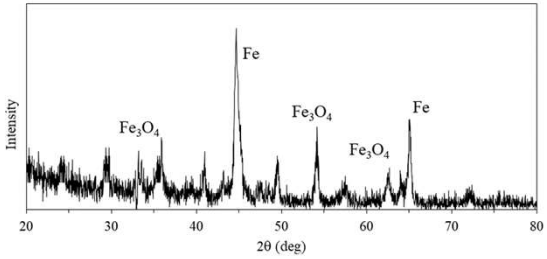

Fig. 4 XRD spectra of produced metallic nanoparticles.

Technologies & Advantages

The advantages of the present invention are numerous and are listed below: 1) The process is sustainable both from an environmental and an economic point of view, since no toxic reducing agents such as sodium borohydride or hydrazine are used, which are also expensive.
2) The process is simple to apply and implement not only on a laboratory scale, as it involves the use of normal easily available equipment and does not require the adoption of high pressures or temperatures, nor of corrosive or chemically aggressive reagents.
3) The process is easily scalable and has a significantly rapid reaction kinetics, exactly like that characteristic of chemical production processes that involve the use of reactants with high reducing power, such as sodium borohydride.
4) Oil wastes and the solvent used for the extraction of reducing compounds are easily available both on the Italian national territory and in the Mediterranean countries of the European Union.

Applications

Metal particles can be used in various industrial fields, mainly as catalysts in the process industry, in fine chemicals, in pharmaceuticals or as a "drug carrier" in the field of anti-tumor medicine or in the biomedical field. Also, metal particles can be used in environmental catalysis processes or as filling materials in composites or in the electronic or optical field, in energy accumulators (batteries) and in the agro-food industry.
The possibility of obtaining the particles in a polyphenolic matrix makes them biocompatible and easily storable.

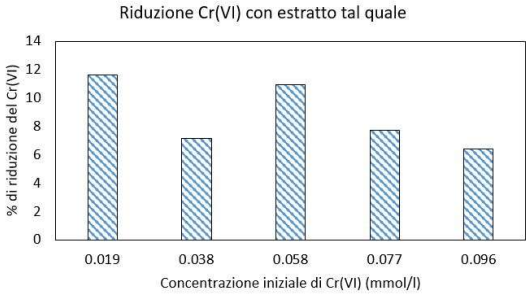

Fig. 5 Cr(VI) reduction test results using extract (initial extract concentration 0.125 mGAE/l).

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