université PARIS-SACLAY | GRADUATE SCHOOL Métiers de la Recherche et de l'Enseignement Supérieur

A LITTLE GOLD TO CLEAN UP OUR ENVIRONMENT

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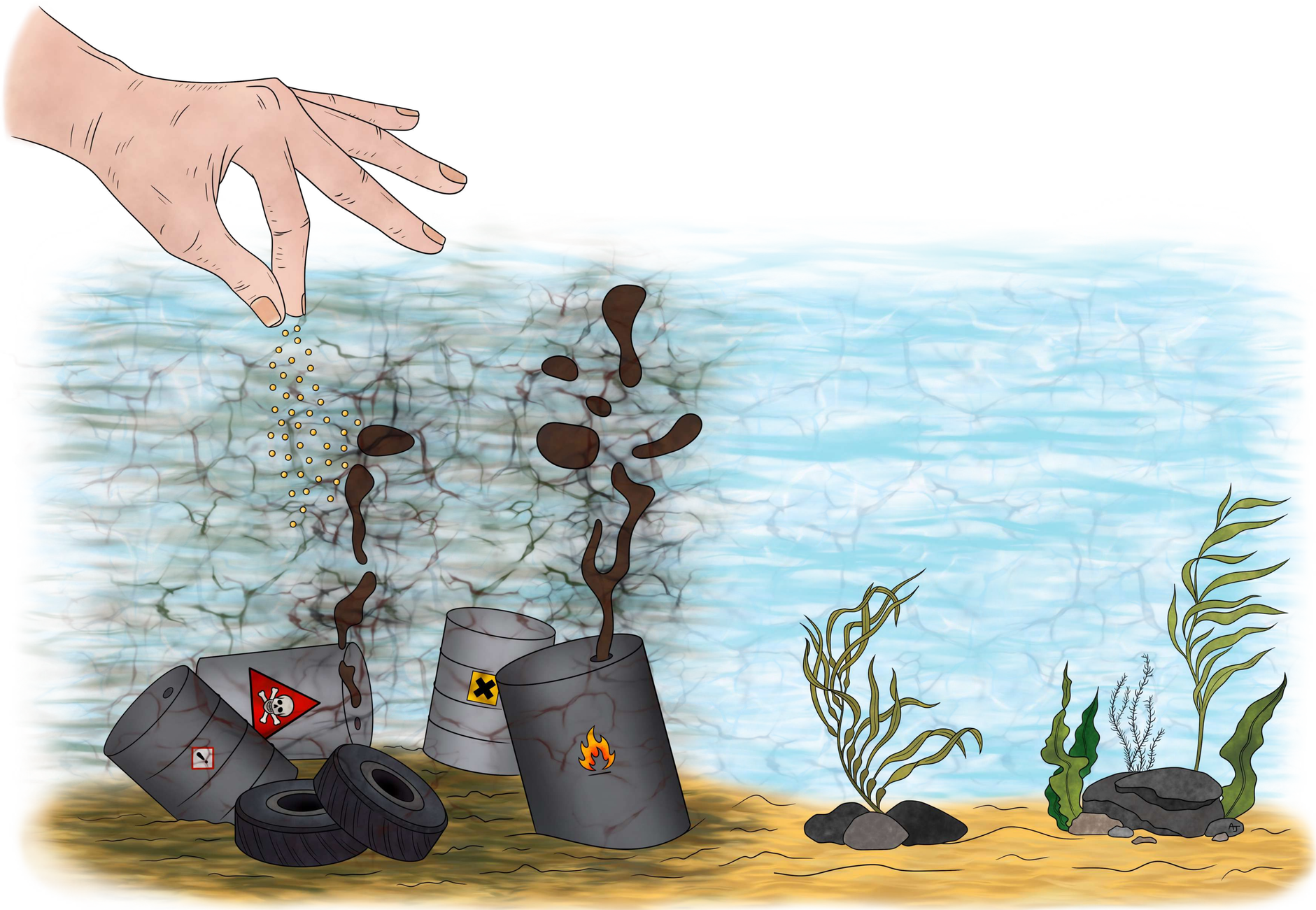
Défi sociétal : Énergie, climat, environnement, développement soutenable



Metallic nanostructures are small objects composed of metal atoms (commonly gold, silver, platinum, and palladium) with at least one dimension ranging from one to a few hundred nanometers. Metallic nanoparticles have been synthesized since antiquity, even if not identified as such, particularly in manufacturing colored glass, due to their interaction properties with light. This can be seen in the stained-glass windows of Sainte Chapelle in Paris (France). Nowadays, these nanoparticles have multiple uses. For instance, platinum and rhodium nanoparticles are used in catalytic converters to reduce pollution from combustion engines, while silver nanoparticles are present in everyday objects (textiles, dressings, refrigerators, etc.) because they have antibacterial properties.

Catalytic activity is a key property of nanoparticles, enabling them to accelerate the rate of chemical reactions without being destroyed in the process. In this way, nanoparticles can be used to transform toxic substances into less harmful substances and make industrial processes more environmentally friendly. The versatility of nanoparticles comes from their unique properties, which are influenced by their shape, size, composition, structure, and assembly. Consequently, these materials exhibit behaviors that differ significantly from those of bulk metals.

Environmentally friendly synthesis methods and effective stabilization agents are required to produce nanoparticles with specific sizes and shapes. One effective method is radiolytic synthesis, which uses radiation to create nanoparticles without the use of extra chemicals. We used the radiolytic method along with a heat-sensitive polymer to create and stabilize gold nanoparticles. Once created and stabilized, we used these gold nanoparticles in the catalytic degradation of model toxic pollutants to demonstrate their efficient catalytic activity. The next step is to design a 3D polymeric structure with adjustable porosity, using the heat-sensitive polymer and to decorate it with nanoparticles for potential catalytic applications. Embedding the nanoparticles on solid support will enhance their reusability and recyclability as catalysts. This approach would address societal challenges in areas such as energy, climate, and environmental remediation. For example, it could be applied to water depollution, and thereby contribute to sustainable development.

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