Amyloid-metal Supramolecular Hybrids for Health and Environmental Remediation Technologies

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Amyloid fibrils interact with metal ions via metal-ligand supramolecular interactions whose energy is of the order of tens to hundreds of K_BT[1]. The occurrence and abundance of the 20 essential amino acids in food-based amyloid fibrils derived from inexpensive animal and plant proteins, including from food waste and agricultural side streams, combined with the extreme aspect ratio of the amyloids, allow for an affordable, yet universal toolbox to produce multifunctional hybrids which can serve in a multitude of applications and technologies. In this talk I will provide several examples of food amyloid fibrils interacting with metal ions and nanoparticles for both health and environmental remediation, some of which have made it into real technologies. Taking β-lactoglobulin amyloids as a model amyloid system derived from whey, a by-product of cheese making process, I will show how metal ions can be adsorbed from water and wastewater solutions by amyloid-based filters for water purification purposes[2], or how gold ions can be adsorbed and processed from amyloid aerogels to recycle gold from e-waste[3]; I will also show how iron atoms can be coordinated to β-lactoglobulin amyloids to deliver highly bioavailable Fe(ii) for iron fortification[4], or to design hydrogels capable of performing cascade enzymatic reactions for alcohol detoxification in vivo[5].
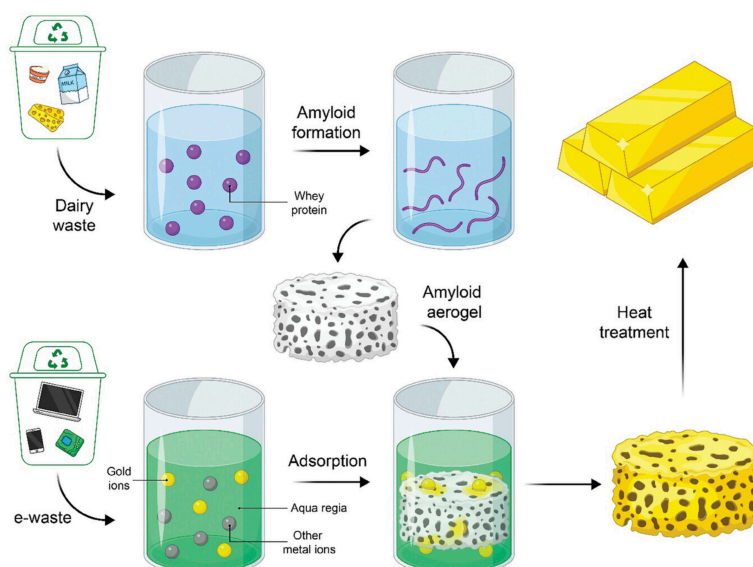

Figure 1. An example of environmental remediation technology enabled by amyloid-metal supramolecular interactions: Gold Recovery from E-Waste by Food-Waste Amyloid Aerogels (reproduced from ref. 3).

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