The "*virtuous* life-cycle of hydroxyapatite": from removal of heavy metals in polluted wastewaters to new ecofriendly catalysts for air-quality protection

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In the last decades, the development and improvement of ecofriendly materials for pollution control have been object of intensive research efforts devoted to comply with the ever more stringent legislative constraints for minimizing harmful emission in water and air.
Among all the calcium phosphate materials, calcium hydroxypatite (HAP, $Ca_{10}(PO_4)_6(OH)_2$) is a versatile material that has gained attention in many fields of applied science because of its typical features (e.g. high chemical and thermal stability, extremely low solubility, low cost, large availability and easy synthesis, and ion exchange capability).
Current studies of our research group have proved that this material is able to permanently immobilize polluting hazardous metallic cations (e.g. Cu, Pb, Cr (1)) present in wastewaters with promising yield of removal, if compared with some others adsorbents.
HAP has also found a role in catalysis because of its easy functionalization (2): several metal species of catalytic interest (e.g. Cu, Fe, Mn) can be deposited on its surface with uniform dispersion of metallic centers thanks to the ion exchange ability offered by its structure. The metal obtained HAP samples possess a double functionality, the amphoteric properties, typical of the bare HAP and the electron transfer ability of the metal centers, that are promising properties that can be exploited in catalysis.

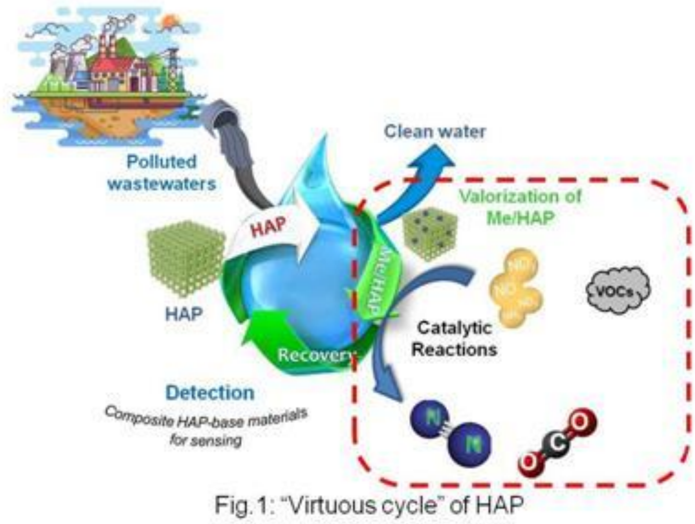

Fig.1: "Virtuous cycle" of HAP

In the view of a more sustainable interaction between environment and industry, we are studying the possibility to employ HAP in a so called "*virtuous* life-cycle" (Fig.1), as sorbent, at first, for removing heavy metals from polluted wastewaters, and then, as metallic catalyst with the possibility to finally recycle both the metallic species and the bare HAP.
In particular, the reuse and valorization of the metal-loaded HAP materials obtained by the first step of de-metallation of wastewaters, allow giving a *second life* to these materials as catalysts in environmental processes for the abatement of harmful gaseous emissions (e.g. de-NOx, de-VOCs, NH_3-SCO, etc.) (3,4).
In this context, the HAP acts as a bridge linking water and air remediation in a fruitful circular process.
This is an interesting example of sustainable process and its realization represents an appealing challenge.

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