

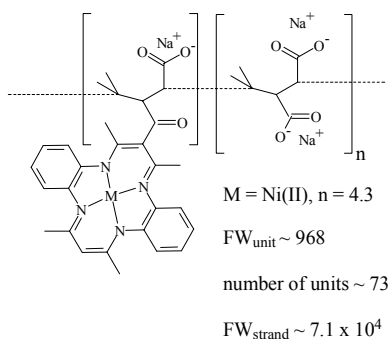
# INORGANIC POLYMERS FOR THE SOLAR CONVERSION OF CHEMICAL WASTES (LIGNIN AND SO<sub>2</sub>) TO MATERIALS OF A STRATEGIC VALUE.

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A strategy based in the use of polymers decorated with transition metal complexes is being applied to two different problems: (a) The solar light-induced reduction of inorganic S(IV) to S<sub>2</sub>O<sub>4</sub><sup>2-</sup> and CO<sub>2</sub> to CO in processes aim to accumulate reduction equivalents. (b) The solar light-induced degradation of the lignin-cellulose complex in a

(I)

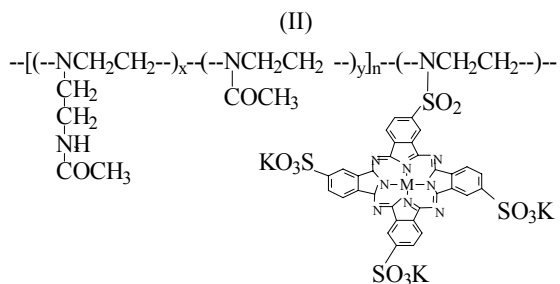


process that liberates forms of the trapped cellulose and low molecular weight phenolic compounds. These groups of compounds are useful raw materials and can be further transformed into fuels.

The reductions of CO<sub>2</sub> to CO and SO<sub>2</sub> to S<sub>2</sub>O<sub>4</sub><sup>2-</sup> as well as the oxidation of SO<sub>2</sub> to SO<sub>4</sub><sup>2-</sup> have been catalyzed with transition metal annulene complexes. All the processes were electrochemically driven. To demonstrate the feasibility of solar-light driven processes, the conversion of CO<sub>2</sub> to CO was effected with a photosensitizer. In the reduction of SO<sub>2</sub> to S<sub>2</sub>O<sub>4</sub><sup>2-</sup>, polymerization of the annulene complex on the surface

of a glassy carbon electrode produced a more efficient catalyst than the monomeric complex. We are investigating therefore the performance of catalysts for the photoinduced reductions of CO<sub>2</sub> to CO and SO<sub>2</sub> to S<sub>2</sub>O<sub>4</sub><sup>2-</sup> where the catalyst consists of annulene complexes appended to a polymer, (I).

Polymers ( poly-Alpc) having Al(III) tetrasulfonated phthalocyanine groups, (II), have been prepared and used for the photodegradation of the lignin. Because the



phthalocyanine chromophore absorbs in the NIR region, it absorbs efficiently the solar light outside the spectroscopic region where the lignin has strong absorption bands. The degradation of the lignin was observed when aerated solutions of the lignin and the poly-Alpc were photolyzed with polychromatic light ( $\lambda > 500$  nm). No degradation of the poly-Alpc occurs in these irradiations. Also, no degradation of

the lignin was observed when it was photolyzed in the absence of the poly-Alpc. Marked differences were observed when the photodegradation of the lignin was induced respectively with Al(III) tetrasulfonated phthalocyanine and poly-Alpc. These difference are partly related to the different mechanism of the photodegradation. While tetrasulfonated Al(III) phthalocyanine probably functions as a photosensitizer converting triplet to singlet O<sub>2</sub>, pendent phthalocyanine radicals and O<sub>2</sub><sup>-</sup> are most likely the reactants in the poly-Alpc photoinduced degradation of lignin.