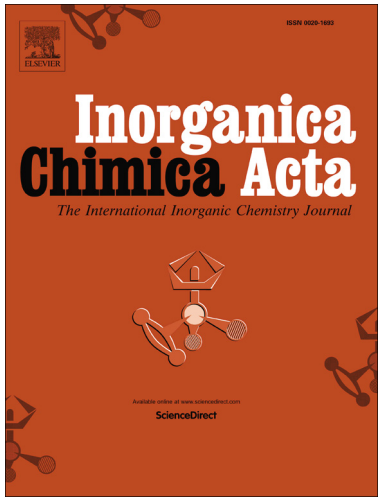

Research paper

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An organic-inorganic nano-hybrid material containing a mixed-addenda Keggin-type polyoxometalate and piperazine: synthesis, characterization and its electrochemical investigation

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Abstract

The synthesis of a new organic-inorganic nano-hybrid material $[H_5O_2][pip]_{2.5}[SiMoV_2W_9O_{40}].7H_2O$ (pip = Piperazine) **(1)**, in which piperazine is connected to a mixed-addenda Keggin structure of polyoxometalate by hydrogen bonding interaction, is reported. This nano-hybrid is characterized by single-crystal X-ray diffraction, fourier transform infrared (FT-IR), proton nuclear magnetic resonance (^{1}H-NMR), powder X-ray diffraction (XRD), thermogravimetric analysis (TGA-DTA), field emission scanning electron microscopy (FESEM) and cyclic voltammetry (CV). Single crystal x-ray analysis reveals that compound **1** has been assembled by hydrogen bonding among polyoxometalate, piperazine and crystallization water units. In this compound, polyoxometalates are located in the cavities which are created by piperazine groups in the zigzag form. In addition, based on XRD and FESEM analyzes, the nano composition of compound **1** can be verified. Moreover, the electrochemical properties of **1** were perused, which represent that **1** has an appropriate electrocatalytic activity towards reduction of nitrate (NO_2^-) ion attributed to the metal-center and piperazine units.

Keywords: Nano organic-inorganic hybrid; mixed-addenda Keggin structure; crystallographic study; electrocatalytic activity