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论文

$\{Mo_{102}\}$型纳米多孔无机富勒烯衍生物的合成、表征及三阶非线性光学性质

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摘要:

在室温酸性条件下, 利用高负电性的表面分布有20个$\{Mo_9O_9\}$型纳米孔道的无机富勒烯囊状阴离子$[\{(Mo^{VI})Mo_5{}^{VI}O_{21}(H_2O)_6\}_{12}\{Mo_2{}^{V}O_4(SO_4)\}_{30}]^{72-}$与胍基乙酸反应, 得到了表面分布有20个$\{Mo_6O_6\}$型纳米孔道的由102个Mo及氧原子组成的$[\{(Mo)Mo_5O_{21}(H_2O)_4SO_4\}_{12}\{Mo^{V}O(H_2O)\}_{30}]^{12-}$小无机富勒烯囊状阴离子. 通过单晶X射线衍射、元素分析、FTIR、UV-Vis、TG-DTA、ESR等手段对其进行了表征. 该化合物属于三斜晶系, *P*1空间群, 晶胞参数a=2.5377(5) nm, b=2.5932(5) nm, c=3.9547(8) nm, α =83.58(3) °, β=86.15(3) °, γ=75.55(3) °, V=25.023(9) nm^3. 利用脉冲时间为5 ns的532 nm激光通过Z-扫描实验得到该化合物的三阶非线性折射率γ=-3.29×10^{-18} m^2/W, 三阶非线性极化率$\chi^{(3)}$=-1.04×10^{-23} $m^2\cdot V^{-2}$, 表明该化合物具有较强的自散焦三阶非线性光学效应.

关键词: 无机富勒烯 纳米结构 非线性光学性质

Synthesis, Characterization and the Third-order Nonlinear Optical Properties of a Derivative of $\{Mo_{102}\}$-type Porous Inorganic Nano-fullerene

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Abstract:

A small spherical inorganic fullerene nano-capsule anion of a formula $[\{(Mo)Mo_5O_{21}(H_2O)_4\cdot SO_4\}_{12}\{Mo^{V}O(H_2O)\}_{30}]^{12-}$ bearing 20 $\{Mo_6O_6\}$-type rings/channels built up from 102 Mo atoms and O atoms were synthesized by reacting a highly charged spherical inorganic fullerene nano-capsule anion with the formula $[\{(Mo^{VI})Mo_5{}^{VI}O_{21}(H_2O)_6\}_{12}\{Mo_2{}^{V}O_4(SO_4)\}_{30}]^{72-}$ bearing 20 $\{Mo_9O_9\}$-type rings/channels with guanidineacetic acid under acidic conditions at room temperature. The crystal structure of the resulted compound were characterized by X-ray single-crystal diffraction, elemental analysis, TG-DTA analysis and FTIR, UV-Vis, and ESR spectrascopies. It crystallizes in a triclinic system space group *P*1, a=2.5377(5) nm, b=2.5932(5) nm, c=3.9547(8) nm, α=83.58(3) °, β=86.15(3) °, γ=75.55(3) °, V=25.023(9) nm^3. Meanwhile, its third-order nonlinear optical properties were studied using *Z*-scan technique with 5 ns laser pulse at λ=532 nm. The third-order nonlinear refractive index of the title compound is determined to be γ=-3.29×10^{-18} m^2/W and the third-order nonlinear susceptibility $\chi^{(3)}$=-1.04×10^{-23} $m^2\cdot V^{-2}$, showing strong nonlinear self-defocusing refractive effects.

Keywords: Inorganic fullerene Nanostructure Nonlinear optical property

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