

研究论文

牛血红蛋白与银纳米粒子相互作用的光谱研究

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**摘要** 运用紫外-可见吸收光谱(UV-Vis)、荧光光谱、同步荧光光谱、圆二色光谱(CD)及傅立叶变换红外光谱(FTIR)等手段, 研究牛血红蛋白(Bovine Hemoglobin, 简称BHb)与银纳米粒子的相互作用. 结果表明, BHb能吸附在银纳米粒子的表面, 使其415 nm处的特征等离子体共振吸收峰强度下降, 峰位红移.

随银纳米粒子的浓度增大, BHb分子中Soret带的吸收持续降低,

说明银纳米粒子可能使部分血红素辅基从它们的键腔中脱离出来. Stern-Volmer方程分析表明,

银纳米粒子静态猝灭BHb的内源荧光. 由UV-Vis和荧光光谱的变化, 计算BHb与银纳米粒子的结合常数,

其数量级达到 $10^9 \sim 10^{10}$ . 同步荧光光谱的蓝移说明, 银纳米粒子扰动BHb分子内部的酪氨酸、

色氨酸残基所处的微环境, 使之包埋于疏水腔中. 拟合计算远紫外CD数据发现,

银纳米粒子诱导BHb产生轻微的二级结构改变,  $\alpha$ -螺旋含量降低. FTIR光谱结果提示, BHb中半胱氨酸残基的硫、羧基氧、酰胺及氨基酸残基中的氮原子与银纳米粒子可能有表面键合作用.

**关键词** [血红蛋白](#) [银纳米粒子](#) [构象变化](#) [微环境](#) [表面键合作用](#)

分类号

**Spectroscopic Studies of Interaction between Bovine Hemoglobin and Ag Nanoparticles**

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**Abstract** The interaction between bovine hemoglobin (BHb) and Ag nanoparticles (Ag NP) has been investigated by ultraviolet-visible, fluorescence, synchronous fluorescence, circular dichroism (CD) and Fourier transform infrared (FTIR) spectroscopies. The decrease and red shift of 415-nm surface plasmon band of Ag NP indicate that the BHb can be adsorbed on the surface of Ag NP. The Soret band was decreased gradually with the increased amount of Ag NP, suggesting the detachment of some heme chromophores from their matrixes in BHb. The fluorescence intensity of BHb was quenched by Ag NP, and the analysis of Stern-Volmer equation reveals that the mechanism may be a static quenching procedure. The binding constant *K* was obtained with calculation of the spectral data, and the order of magnitude of *K* was found to be  $10^9 \sim 10^{10}$ . The blue shift of synchronous fluorescence spectra reveals that the microenvironments around tryptophan and tyrosine residues were disturbed by Ag NP, to make the residues buried inside the hydrophobic cavities. The calculation of far-UV CD data showed that the secondary structure of BHb had slight changes, and the  $\alpha$ -helical content was decreased. In addition, the FTIR spectra could provide the evidence that the sulphur atoms of cysteine residues, carboxyl oxygen, and nitrogen atoms of peptide or residues probably have the direct chemical bonds to surface of Ag NP.

**Key words** [hemoglobin](#) [Ag nanoparticle](#) [conformational change](#) [microenvironment](#) [bond to surface](#)

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