Optimization of Synthesis of Bovine Serum Albumin-Encapsulated Gold Nanoclusters

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Introduction:

Gold nanoclusters (AuNCs) are nanoscale structures consisting of a few to tens of gold atoms. AuNCs exhibit size and scaffold-dependent photoluminescence which allows their usage as analytical sensors (detection of metallic ions, molecules, pH and temperature), catalysts and fluorescent probes for biological imaging [1,2,3,4,5,6]. Different synthetic approaches and conditions can lead to specific optical properties of AuNCs [7,8,9,10,11]. In this contribution, we are dealing with various molar ratios of precursors (namely, BSA, $HAuCl_4$ and NaOH) in order to improve the fluorescent characteristics of AuNCs (particularly, quantum yield Φ).

Chemicals:

BSA (≥98%), $HAuCl_4$ (≥99.9%), NaOH (≥98.0%) were purchased from Sigma-Aldrich.

Synthetic procedure:

BSA + $HAuCl_4$ → NaOH → MW irradiation

Results:

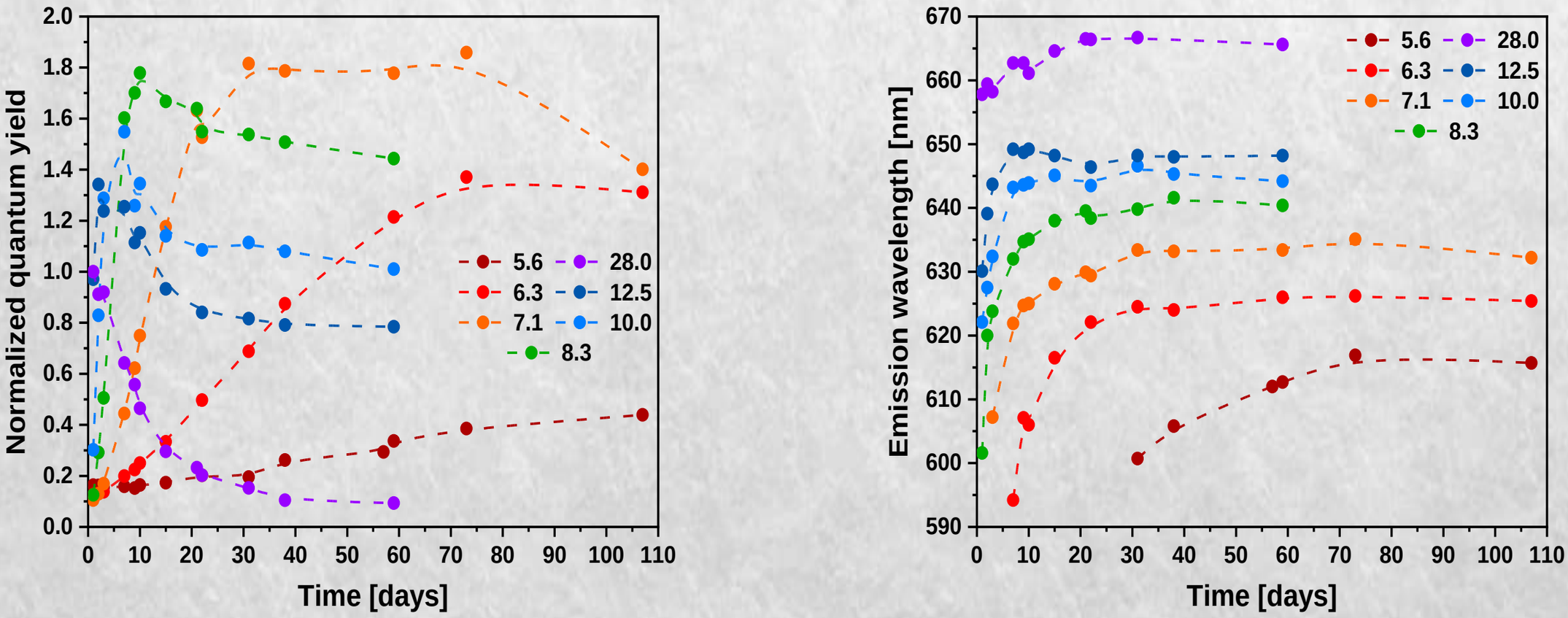

Figure 1: *Normalized quantum yield (left) and emission wavelength maximum (right) as a function of period of sample ageing at room temperature for different molar ratios of NaOH:$HAuCl_4$ (5.6, 6.3, 7.1, 8.3, 10.0, 12.5 and 28.0), respectively. Note: Normalized quantum yield is calculated according to the classical equation for quantum yield determination where instead of chromophoric standard, the values of absorbance and integral fluorescence intensity for the first synthesis is used and its quantum yield is set to 1.*

Equation for quantum yield determination:

$$\Phi = \Phi_s \cdot \frac{F \cdot (1 - 10^{-A_s}) \cdot n^2}{F_s \cdot (1 - 10^{-A}) \cdot n_s^2}$$

where F is the integrated fluorescence intensity, A is the absorbance, n is the index of refraction, and subscript s indicates the standard.

Conclusion:

The most significant parameter influencing the resulting fluorescent characteristics of AuNCs appears to be the pH, which is closely related to NaOH:$HAuCl_4$ ratio. The optimized conditions for AuNCs prepared by this type of synthesis appears to be reached at the ratio of 8.3. Furthermore, the hypsochromic shift of the emission maximum was observed with decreasing NaOH:$HAuCl_4$ ratio.

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Acknowledgement:

This research was funded by Grant Agency of the Czech Republic, grant number 19-03207S and Internal Grant Agency of Palacký University, grant number IGA_PrF_2021_003.