

Supporting Information

Surface-engineered Design of Efficient Luminescent Europium(III) Complex-based Hydroxyapatite Nanocrystals for Rapid HeLa Cancer Cell Imaging

Takuya Kataoka,¹ Shigeaki Abe,² Motohiro Tagaya^{1,*}

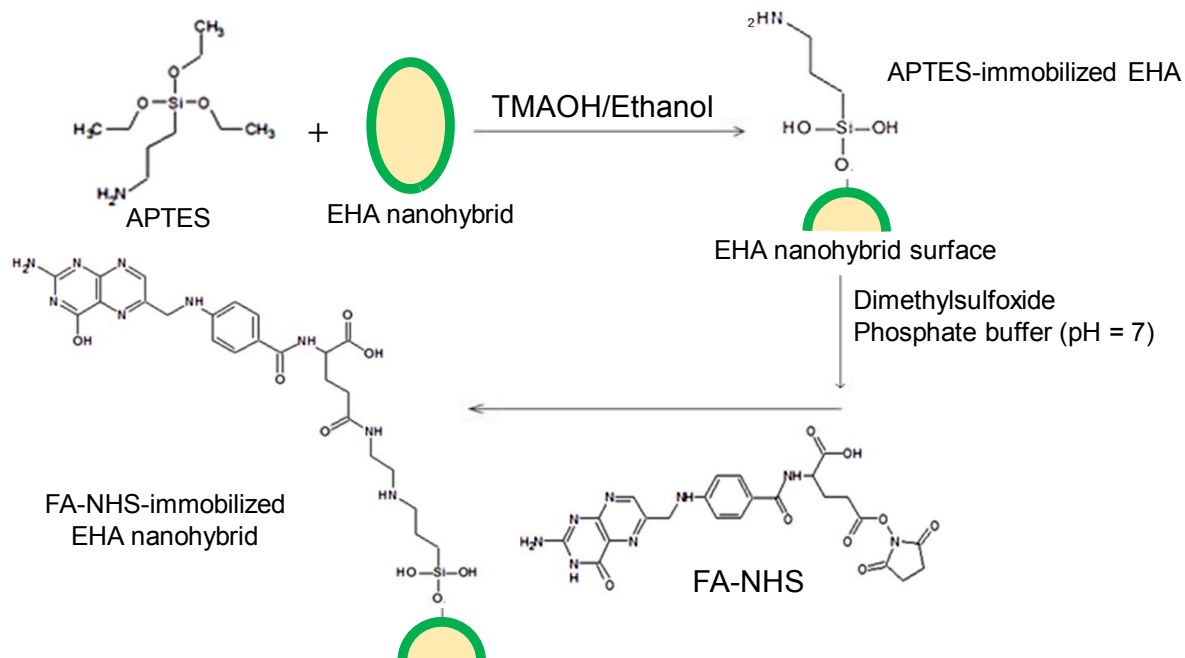
^{1.} Department of Materials Science and Technology, Nagaoka University of Technology, 1603-1 Kamitomioka, Nagaoka, Niigata 940-2188, Japan

^{2.} Graduate School of Dental Medicine, Hokkaido University, Sapporo 060-8586, Japan.

*** Author to whom correspondence should be addressed:**

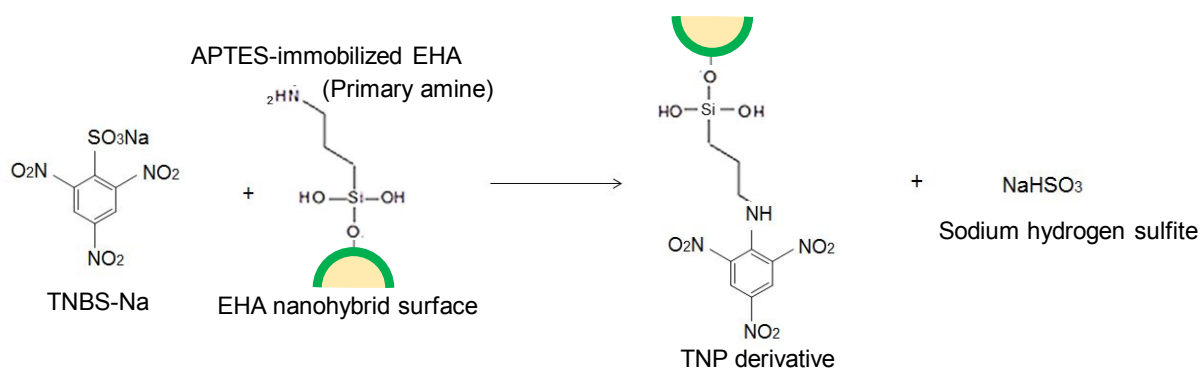
Tel: +81-258-47-9345; Fax: +81-258-47-9300, E-mail: tagaya@mst.nagaokaut.ac.jp

Scheme S1



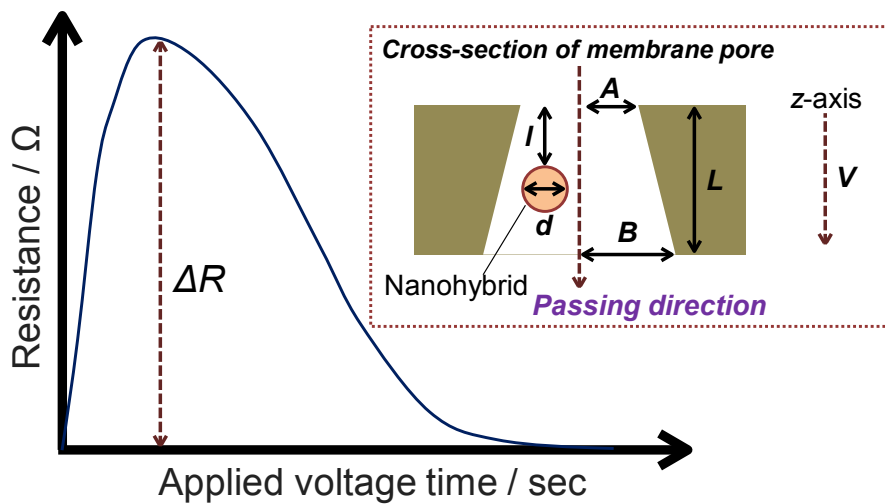
Scheme S1. Immobilization processes of FA-NHS on the EHA nanohybrid surfaces.

Scheme S2



Scheme S2. Reaction pathway of primary amine in NH₂-R (R=EHA nanohybrid) with TNBS-Na.

Scheme S3



Scheme S3. Illustration of the resistive pulse curve to indicate the maximum resistance change (ΔR) from the baseline level with the applied voltage time. Inset: illustration of the cross-section of membrane pore structure with the passing of particle along with the axis of a conical pore.

Figure S1

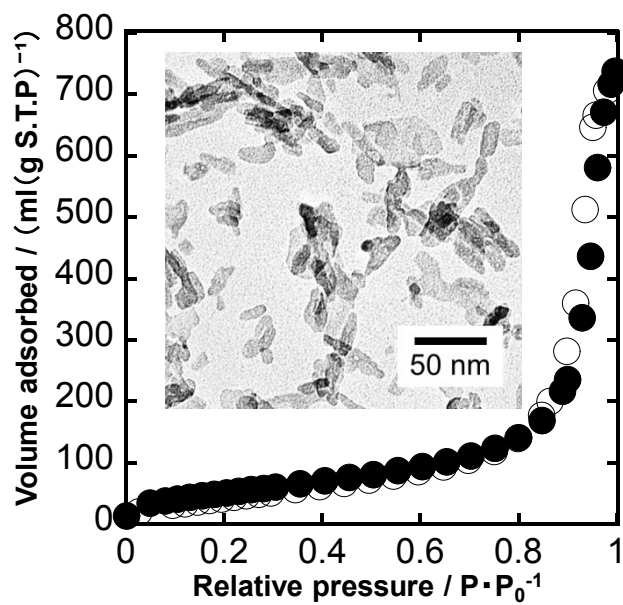


Figure S1. Nitrogen adsorption (closed circles) and desorption (open circles) isotherms of the EHA nanohybrid. The BET surface area (S_{BET}) was 196 m²g⁻¹. (Inset) TEM images of the EHA nanohybrids.

Figure S2

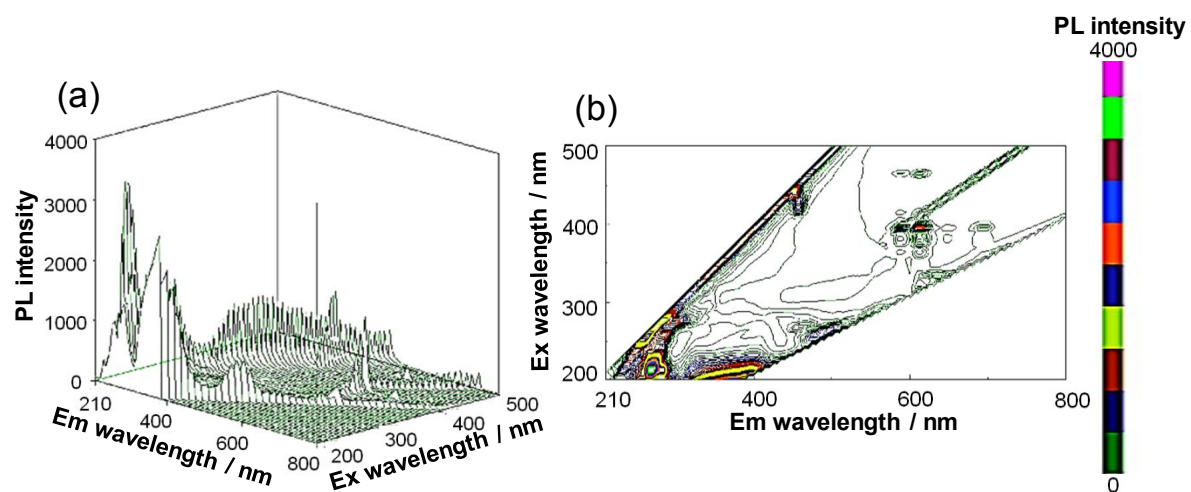


Figure S2. (a) 3D excitation (Ex) and luminescence (Em) spectra of the EHA nanohybrid and (b) the 2D PL intensity mapping.

Figure S3

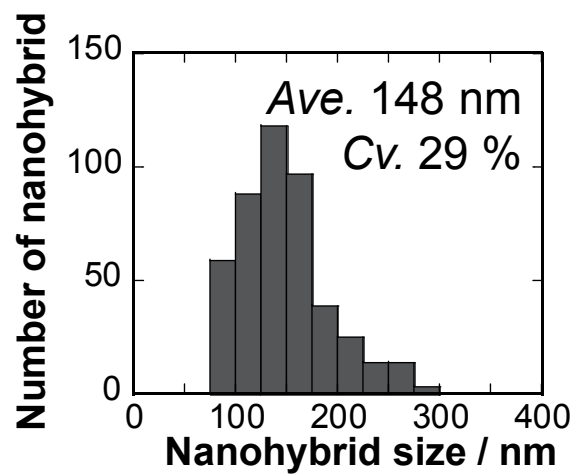


Figure S3. Particle size distribution of the EHA nanohybrid.

Figure S4

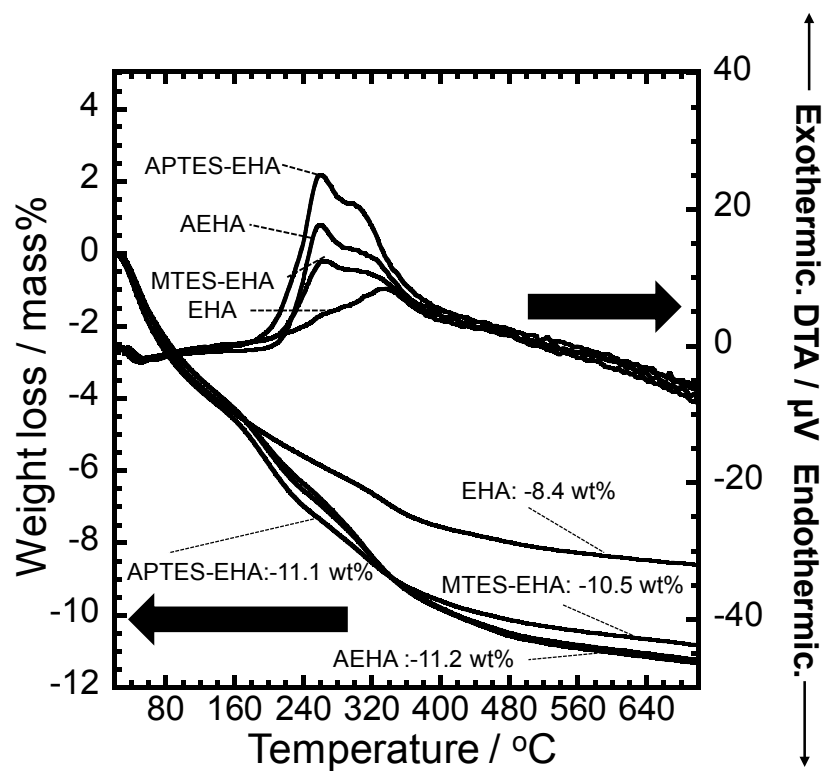


Figure S4. TG-DTA curves of the APTES-MTES-co-immobilized EHA nanohybrids.

Figure S5

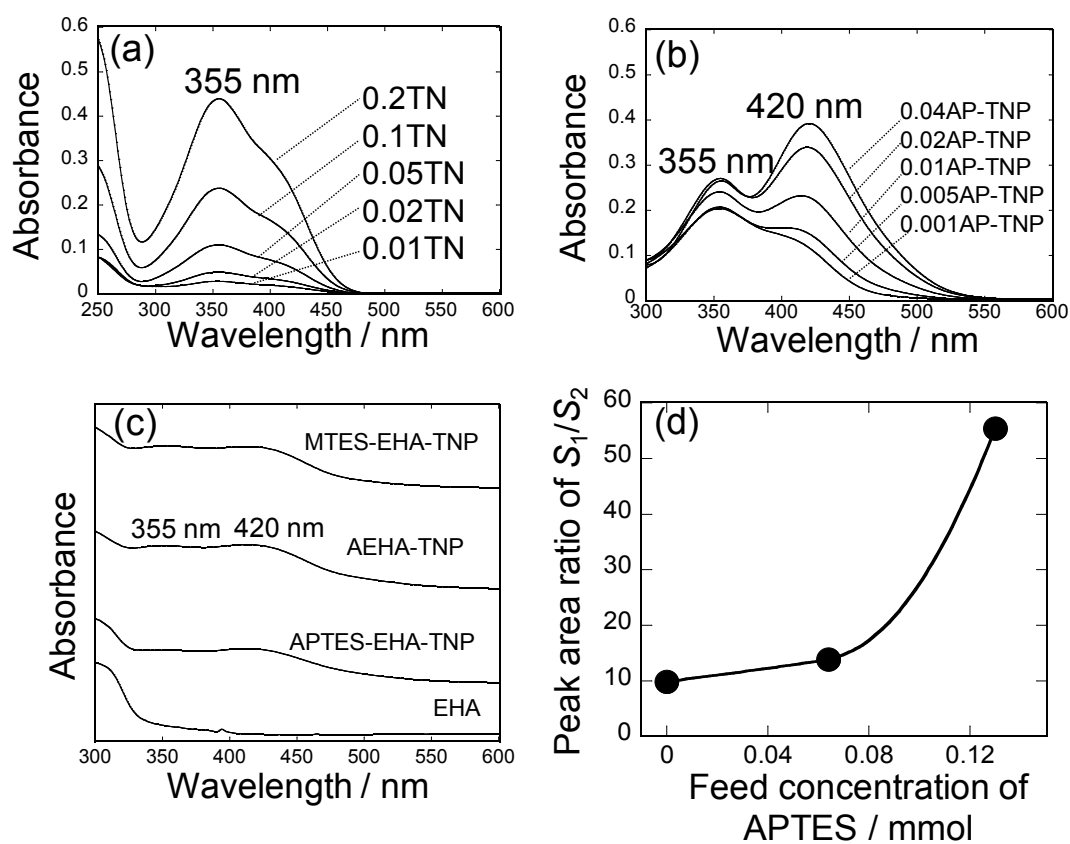


Figure S5. UV-Vis absorption spectra of (a) TNBS solutions with the different concentrations and (b) the TNBS-stained APTES solutions with the different concentrations. (c): UV-Vis diffuse reflection absorption spectra of the TNBS-stained APTES-MTES-co-immobilized EHA nanohybrids and (d) the change in the peak area ratio of S_1 (374–495 nm) to S_2 (333–379 nm).

Figure S6

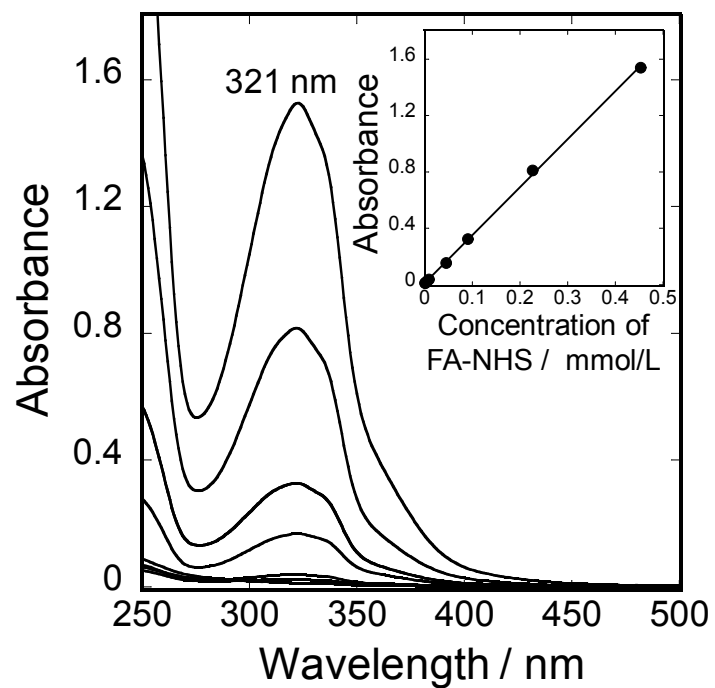


Figure S6. UV-Vis absorption spectra of the FA-NHS solution at the pH of 2. (inset): the calibration curve between the FA-NHS concentration and absorbance ($R^2= 0.99974$).

Figure S7

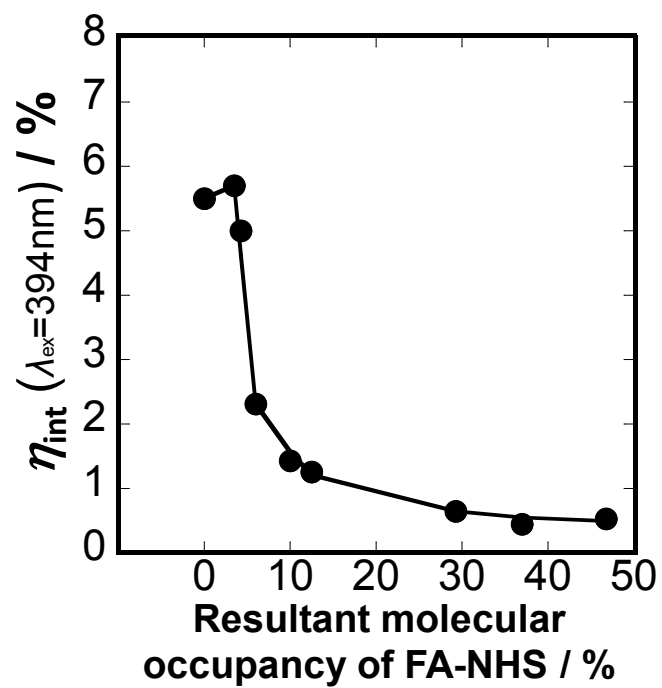


Figure S7. η_{int} of the FA-NHS-immobilized EHA nanohybrids under the excitation wavelength of 394 nm.

Figure S8

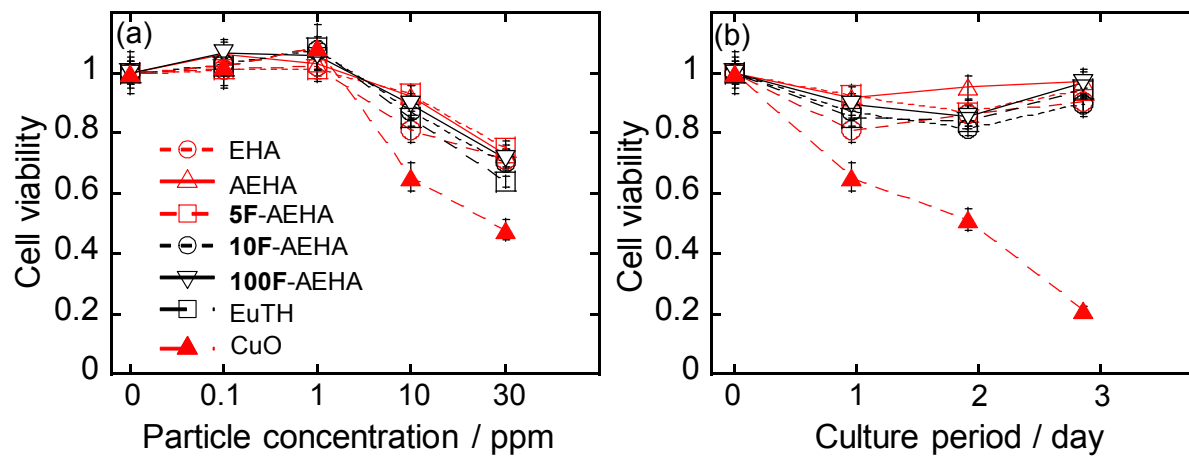


Figure S8. The cell viability changes with (a) particle concentration (culture time: 24 h) and (b) culture period (particle concentration: 10 ppm).