Control of plasmon wavelengths and photothermal conversionproperties of plasmonic aluminum nanocaps for photothermal therapy nanomaterials

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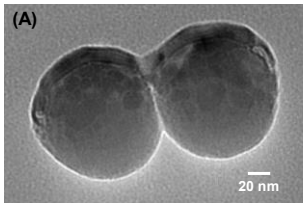
Photothermal therapy (PTT) is a cancer treatment that has attracted much attention in recent years. The use of metal nanomaterials has been extensively studied from the point of view of their ability to efficiently absorb and convert light into heat in biological transparent windows in a near-infrared region through the excitation of localized surface plasmon resonance (LSPR).[1] We propose aluminum nanocaps in the shape of anisotropic open-shell nanostructure as a low-cost photothermal therapy agent, which can function in a second biological transparent window (1000-1350 nm). Because the penetration depth of light within a first biological transparent window (750-900 nm) into the biological tissues and the permissible irradiation intensity is limited.

It was confirmed from the TEM image (Fig. 1(A)) that hybrid structures consisting of silica nanoparticle (used as a template) with an average diameter of 217 nm and aluminum nanocaps. The extinction spectrum (Fig. 1(B)) of the colloidal aqueous solution of aluminum nanocaps shows a broad band with a peak at 1270 nm and the dip around 808 nm seems to be attributed to the localized bandgap transition of Al. Figure 2 shows a temperature rise by irradiating the colloidal solution (extinction intensity : 0.3483) with a continuous laser with 1060 nm (1.0 W). The temperature was saturated at 41.8 °C and the photothermal conversion efficiency was calculated to be 69.6%, which was high as those of other anisotropic gold nanoparticles.[3] We will also discuss in the presentation the selection of protective agent for the aluminum nanostructures.



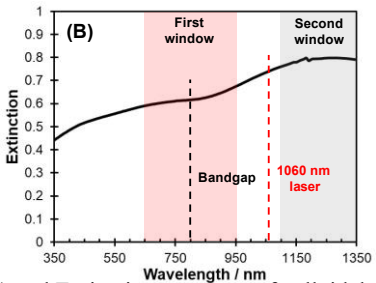


Fig.1 TEM images of AlNCs (a) and Extinction spectrum of colloidal solutions of AlNCs (b)

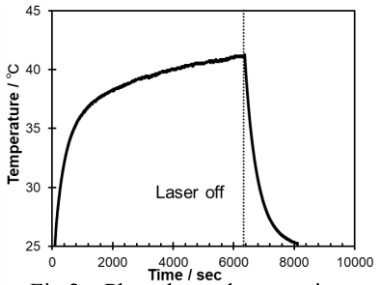


Fig.2 Photothermal conversion properies of AlNCs@SiO_2

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