Dynamically Securing the Data by 1O2 Sensitization of Fluorescent Composites with A High Latency and Uncrackable Features

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Abstract

Dynamic fluorescent materials used in data encryption suffer from photodegradation, poor latency, and susceptibility to unauthorized access. Herein, we propose a photochemically modulated dynamic fluorescent encryption system based on 1O2 sensitization of fluorescent composites, comprising a 1O2-sensitive fluorophore (F2) and non-emissive polymers. After UV irradiation, in-situ generation of 1O2 from the polymer effectively binds with F2 to form endoperoxides (F2EPO), resulting in a significant redshift in emission, up to 150 nm. The 1O2 concentration is closely related to the irradiation time, enabling time-gated encryption with diverse fluorescent colors. Moreover, polymer properties can be manipulated to further regulate F2EPO emission. Relying on these merits, we develop a dynamic data encryption method with various non-emissive polymers as the data storage media, UV light irradiation as the data encoder, and F2 as the data decoder. UV light irradiation of diverse polymer solutions generates 1O2 at different concentrations, effectively encoding the data, which remains invisible under both UV and natural lights. The addition of F2 to these irradiated polymer produces different redshifted fluorescence, enabling secure data decryption. Attributing to the non-emissive polymers, time-gated readout fashion, excellent latency of 1O2, and subtle interactions between 1O2 and F2, this data encryption is nearly undecipherable.

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