Filter-free luminescence diagnostics using upconverting nanoparticles

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Portable devices are emerging as potential diagnostic platform for mobile healthcare. A key factor to accelerate such applications is to equip mobile device with a capacity for molecular diagnostics. As opposed to simple color photography which is well implemented on most modern smartphones, fluorescent sensing is still challenging because optical filter sets used for fluorescent detection are not built in. In addition, without sophisticated optics, background autofluorescence from samples interferes true fluorescent signal. We report a new detection method that obviates the need for filters and is much more sensitive since the target signal can be integrated. This approach exploits the unique optical properties of upconverting nanoparticles (UCNP). Optically excited UCNP emits long lifetime (several milliseconds) luminescent light even when the exciting light is turned off. This feature enables filter-free imaging of the particles by time-gated fluorescence imaging. Importantly, the method eliminates the interference from excitation light and short-lived background autofluorescence, which significantly improves the signal-to-noise ratio. We expect this portable and sensitive time-gated imaging system is applicable for detecting disease markers.