NOVEL OPTICAL SCATTERING LABELS BASED ON DIAMOND NANOCRYSTALS FOR CELLULAR IMAGING

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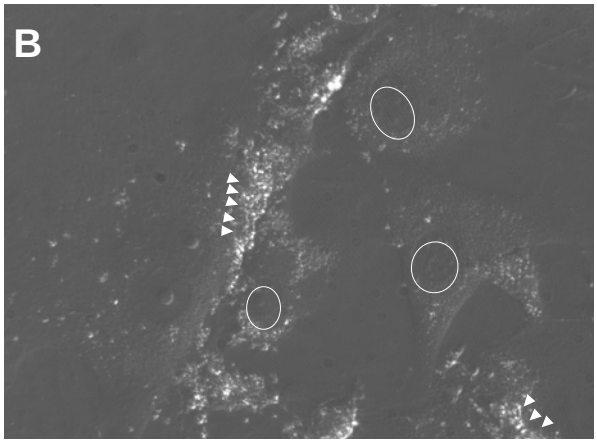
In biological imaging, site-specific optical labelling generally classified as luminescent and scattering provides superb discrimination between the sites of interest and the cell background. Luminescent optical labels include fluorescent dyes and quantum dots[1]. Scattering labels include plasmon-resonant particles. The scattering cross section of an 80 nm diameter silver sphere is typically 10^6-fold that of a single fluorescent dye. However, thermal perturbation of biological environments (several deg) and unpredictable catalytic properties of these particles are disturbing issues for biologists. Luminescent nanocrystals (e.g., nitrogen-associated vacancy defect in diamond[2]) represent a luminescent label encapsulated within a scattering optical label and display a blend of merits: high-contrast imaging due to the spectral separation of excitation–emission bands, photostability, immunity to the environment, and strong elastic scattering owing to the high refractive index relative to that of the biological medium[3]. We report on our preliminary investigations of scattering nanodiamonds (SND), as applied to optical cellular imaging.

The scattering properties of SNDs were characterised by performing optical imaging of a sample that represented a glass cover slip spin coated with 55-nm diamond nanocrystals. The microscopic observations showed that the nano-scale SNDs are clearly detectable on a clean glass substrate and also embedded in a weakly scattering polymer. The brightness of the SND's diffraction-limited spot has been demonstrated to serve as a reliable measure of the particle size. These observations were followed by imaging of live epithelial cells that contained SNDs transfect through the cellular membrane, as shown in figure. SNDs are clearly observable as bright dots accumulated inside the cells in comparison with e.g. endosomes having relatively dim appearance. The application scope of bright dielectric nanocrystals is envisaged in optical labelling of weakly scattering biological specimens for biological studies.



Differential-interference-contrast image of the of the 3T3 cell culture layout showing the presence of scattering nanodiamonds that transfect into the cells. White circles indicate nuclei while SND (indicated by white triangles) are visible as brightly white structures.

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