Interaction dynamics of the nanodiamond with living cells in culture

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Cells of four cell lines (HeLa, SPEV, human endotheliocytes and lymphoblasts MOLT-4) were cultivated in cell culture medium with water suspension of nanodiamonds (ND) for 15 min, 2, 8 and 24 hours. Three different suspension types were tested: pristine ND, ND modified with anxiolytic and ND modified with antibiotic (ND-A). After fixation cells were embedded in Epon resin by standard methods and ultra-thin sections (75 nm) were then observed in transmission electron microscope (TEM) JEM 1011 (Jeol).

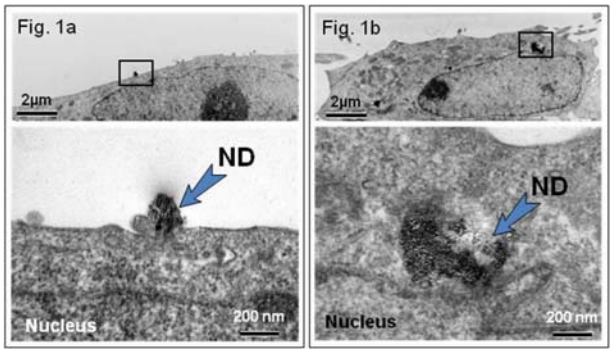

Figure 1. TEM images of HeLa cell cultivated 15 min with ND (**a**) or ND-A (**b**). Upper photos presented total cell view, down photos - magnified selected regions with ND.

Ultrastructural study showed that within 15 minutes of incubation ND aggregates were connected with cell membranes (Fig.1a). In TEM ND particles were clearly visible against the background of cellular structures without any additional staining. They represented very contrasting nanocrystals measuring about 5 nm. Cell membranes interacted with ND conjugates and formed intussusceptions, which gradually deepened leading to penetration of ND into the cell. 3D analysis on serial ultrathin sections revealed that part of the ND-A is found inside cells within 15 min of incubation. These conjugates were observed within the cytoplasm not surrounded by any membrane. It was also discovered that ND conjugates interacted with the outer nuclear membrane (Fig.1b). Our results demonstrated that the penetration of ND-A was more active than of pristine ND.