

One but not the same: Uptake of graphene oxide by Caco-2 cells is dependent on cell morphology and topography

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Abstract

In a recent study we have shown that exposure of Caco-2 cells to four different graphene oxides (GO) for up to 48 hours did not lead to acute toxicity, despite the development of reactive oxygen species and close GO-cell surface interaction [1]. Nevertheless, it was not clear if the close cell-surface interaction can lead to cellular uptake of the GO. Several research groups have shown that different cell types are able to take up graphene oxide *in vitro*. But clear evidence for uptake of GO by human intestinal cells has not been given to date. Aim of our study was to explore the uptake of two different GO by Caco-2 cells *in vitro*. Due to the fact that Caco-2 cells can be applied in different phenotypes we assessed the uptake behaviour of non-confluent as well as differentiated Caco-2 cells. By transmission electron microscopy (TEM) analysis we found considerable amounts of internalized GO in non-confluent Caco-2 cells. Even uptake of large micro-sized GO sheets could be found. Scanning electron microscopy (SEM) analysis of the Caco-2 cell surface revealed the formation of wave-like membrane structures associated with the GO sheets giving hints towards an active uptake process. In contrast, by TEM analysis of differentiated Caco-2 cells exposed to the same GO samples, we could not find any internalization of the applied GO at all. The results show that polarization and differentiation of Caco-2 cells have a dramatic influence on the graphene oxide uptake behaviour.

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References

[1] M. Kucki, P. Rupper, C. Sarrieu, M. Melucci, E. Treossi, A. Schwarz, V. León, A. Kraegeloh, E. Flahaut, E. Vázquez, V. Palermo, P. Wick: "Interaction of graphene-related materials with human intestinal cells: an *in vitro* approach"; submitted