

# Piezoelectric nanoparticles for mesenchymal stem cell stimulation

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The challenge to guide and control stem cell fate has been addressed in multiple ways by researchers, making it self-evident that biomedical nanodevices can play a key role in regenerative medicine. This includes the development of nanomaterials which are chemically and/or physically active and the joint capability of controlling their response at the nanoscale. A step further in this pathway may be achieved using intracellular nanotransducers based on piezoelectric nanomaterials, since they can be activated by a wireless system (simply, ultrasound waves) placed outside the cell/tissue/organ of interest. It is a matter of fact that nanoparticle-based strategies for nanomedical applications retain a salient potential for forefront advancements associated with important toxicological hurdles. The balance of such properties has thus become an intriguing challenge for a successful development of therapeutically effective nanosystems. Boron nitride nanotubes (BNNTs) are ceramic nanomaterials provided with excellent piezoelectric properties, enabling them to convert mechanic into electric energy, and *viceversa* [1]. The effectiveness of this stimulation method (*i.e.*, US-activated BNNT-mediated stimulation) has been recently demonstrated by our group using neuronal-like cell lines [2].

Here we report our preliminary findings on the interactions of BNNTs with pluripotent cells, such as human mesenchymal stem cells (hMSCs) from the bone marrow (BM), hMSCs from trabecular bone (TB) and hMSCs from dental pulp (DP). Internalization and cytotoxicity were evaluated at different times. Our preliminary cytotoxicity assessment allowed the establishment of a non-toxic BNNT concentration to be used *in vitro* with MSC cultures. Moreover, investigation with transmission electron microscopy (TEM) confirmed that BNNTs were internalized at cytoplasm level, being mainly detected in membranal vesicles. Such results highlight the appealing property of biocompatible piezoelectric nanotransducers to trigger “electrically-sensitive” cell differentiation processes, thus disclosing future intriguing implications for new regenerative therapies.

## References

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