# Aqueous dispersion of various types of carbon nanotubes at high concentrations using Pluronic F127

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**Abstract**
Carbon nanotubes (CNTs) are finding widespread applications in various fields including catalyst supports, optical devices, quantum computers, and biomedical field due to their unique electronic, thermal, optical, and mechanical properties [1, 2]. Most of these applications require stable suspensions of high concentration of CNTs. The non-covalent functionalization technique of producing CNT suspensions is better in the sense that it does not alter the inherent electrical, optical or mechanical properties of CNT. In this route, CNTs are commonly dispersed using various surfactants, such as etyltrimethylammonium bromide, Triton X-100, sodium dodecylbenzene sulfonate (SDBS), Pluronic F127, etc. [3], with the help of ultrasonication process, which breaks down or de-bundles the CNT aggregates. The treatment time or energy of the ultrasonication process has strong influence on CNT dispersion and within limits, longer is the treatment time (and higher is the ultrasonication energy), better is the CNT dispersion. However, a longer ultrasonication treatment or higher ultrasonication energy may also reduce the aspect ratio and lead to CNT damage. From this point of view, a short and mild dispersion process is always favourable. On the other hand, among the various surfactants, currently Pluronics are finding a special attention due to its biocompatibility and lower toxicity as compared to other surfactants [4]. However, only limited number of research studies has been carried out till date on the aqueous dispersion of CNT using Pluronic, especially at high concentrations.

The present paper reports the aqueous dispersion behaviour of various types of CNT (single-walled and multi-walled, both pristine and functionalized) using Pluronic F127. Various concentrations (0.1 to 0.3 wt .%) of CNT were dispersed in water using different concentrations of Pluronic, in order to find the optimum Pluronic concentration with respect to CNT concentrations. A short (only one hour) and mild ultrasonication process was used to prepare the aqueous suspensions. The quality of aqueous suspensions was characterized using optical and scanning electron microscopy (SEM). The concentration of dispersed CNTs was measured using UV-Vis spectroscopy and the adsorption of Pluronic F127 on CNTs was confirmed through ATR spectroscopy. The dispersion behaviour of different types of CNT using Pluronic F127 has been compared with that using Sodium dodecylbenzene sulphonte (SDBS) at previously reported concentrations.

It was observed from the optical microscopy and SEM study that the optimum concentration of Pluronic F127 leads to homogeneous dispersion of various types of CNT (without agglomeration), similar to SDBS. UV-Vis spectroscopy revealed that the used dispersion process using both Pluronic F127 and SDBS leads to stable dispersion of high concentrations of CNT. However, the concentrations which could be dispersed using SDBS were higher than Pluronic F127, although the long term stability of the suspensions was higher in case of Pluronic F127.

## References

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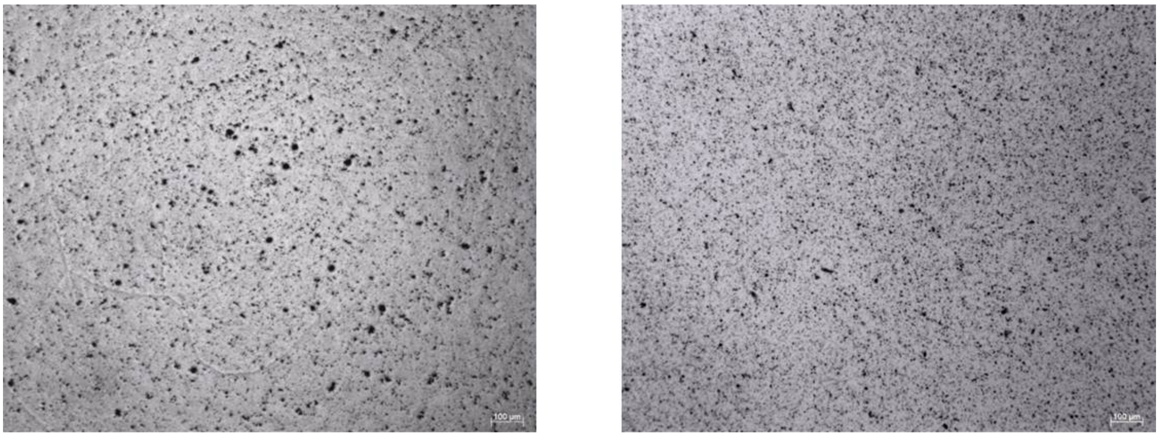
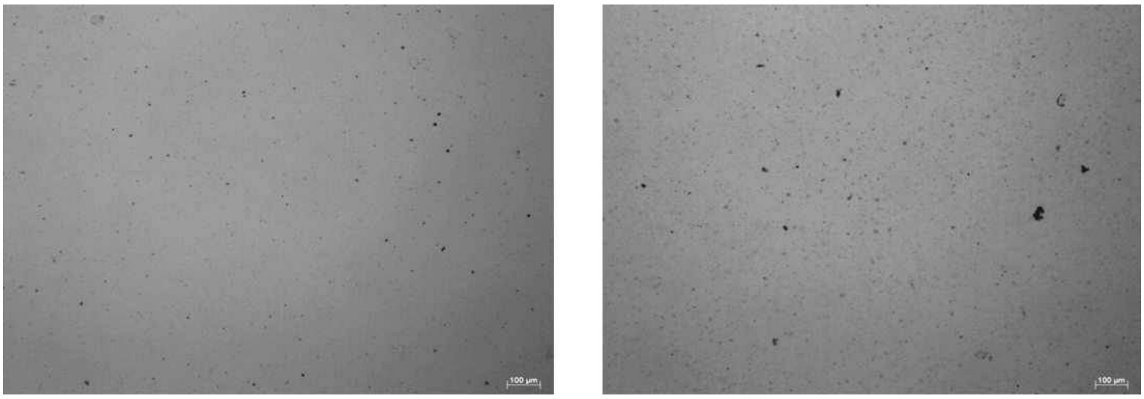
**Figures**



(a) (b)

Figure1. Aqueous dispersion (0.1 wt. %) of pristine single-walled nanotubes (a) and multi-walled nanotubes (b) prepared using Pluronic F127



(a) (b)

Figure 2. Aqueous dispersion (0.1 wt. %) of pristine single-walled nanotubes (a) and multi-walled nanotubes (b) prepared using SDBS