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The role of surfactants with different length of alkyl chains in the dispersion of carbon nanomaterials

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Carbon nanofluids (suspensions of carbon nanomaterials) have been proven to have wide variety of distinct applications, starting from thermal conductivity [1] to creation of microcapsules [2]. Improving the stability of such suspensions would have a great impact on development of new materials. Furthermore, the possibility to manipulate surface properties of carbon nanofluids (CN) would be of great use to numerous industrial applications. The discovery new synthesis methods of carbon nanotubes, fullerene or graphene offers exciting opportunities for the development novel high property materials. It is very important to learn how to manipulate the surface properties in order to achieve products with the desired properties.

Carbon nanomaterials (CN) show very strong surface hydrophobic interactions [3]. In our work we focused on the noncovalent modification of carbon surface using dicationic surfactants in aqueous solution. The surfactant molecules can create for example steric barrier between CN surfaces [4]. Surfactants can interact with CN through various interaction modes: hydrophobic interaction between aliphatic chains of surfactants and side walls of CN [5] or π-π interaction of imidazolium rings from surfactant molecules with CN surface [6]. So far in several works have been reported the dispersion of multi-wall carbon nanotubes by conventional single chain surfactants, like SDS, CTAB or DTAP.

In this work we focused on amphiphilic dicationic surfactants, known as gemini surfactants. This type of surfactants have a number of unique aggregation properties in comparison to conventional single-chain surfactants, such as: low CMC, ability to form of different morphology of aggregates and others [7].

For this study we selected a series of gemini surfactants (with imidazolium head groups) with different length of alkyl chains, with potential applications as efficient systems for dispersing nanostructures in aqueous solutions.

The stability of the CN suspensions in water solutions was investigated using UV/VIS spectroscopy. The CN concentration was fixed and only selected concentrations of surfactants were tested to evaluate their stabilization efficiency. The microstructure of the stable, concentrated suspensions of CN was investigated using high-resolution Transmission Electron Microscopy. In addition NMRD (nuclear magnetic resonance dispersion) profiles were also examined in order to check quantative parameters of stability of selected suspensions.

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