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Influence of molecular structure and temperature on the adsorption behavior of PEO-PPO-PEO surfactants: A QCM-D study

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Poly(ethylene oxide)-poly(propylene oxide)-poly(ethylene oxide) block copolymer surfactants (poloxamers or pluronics) are used as stabilizer in various nanosuspensions, e.g. of rilpivirine, danazol, diclofenac, asulacrine and itraconazole. In order to have a stabilizing effect on hydrophobic particles, these PEO-PPO-PEO surfactants should adsorb to the particle surface. In this research, the adsorption behavior of pluronics with two different ethylene oxide contents (50% and 80%) and three different molecular weights of the propylene oxide part (i.e. 950, 1750 and 3250 g/mol) was studied at 20°C and 37°C onto gold sensors coated with 1-undecanethiol using a quartz crystal microbalance with dissipation (QCM-D). Pluronic solutions with 5 different concentrations were used, ranging from 0.02 mg/ml to 50 mg/ml. Our results indicate a significant (linear) effect of the pluronic concentration on the average adsorption during the adsorption steps. No clear effect could, however, be detected after rinsing of the sensors with ultrapure water. The molecular weight of the PPO part seemed to have a proportional effect on the adsorbed amounts after rinsing, but no clear effect during the adsorption steps. The ethylene oxide content seemed to have an effect during both the adsorption and rinsing steps. Also, our results indicated no significant difference in the average adsorbed amount during both the adsorption and rinsing steps at 20°C and 37°C. The obtained results were useful to gain more insight in the stability differences between nanosuspensions with different pluronic concentrations (and molecular structure).

Recent Publications

1. Baert L et al. (2009) Development of a long-acting injectable formulation with nanoparticles of rilpivirine (TMC278) for HIV treatment. European Journal of Pharmaceutics and Biopharmaceutics. 72(3):502-508.
2. Crisp M T et al. (2007) Turbidimetric measurements and prediction of dissolution rates of poorly soluble drug nanocrystals. Journal of Controlled Release. 117(3):351-359.
3. Lai F et al. (2009) Diclofenac nanosuspensions: influence of preparation procedure and crystal form on drug dissolution behavior. International Journal of Pharmaceutics. 373(1-2):124-132.
4. Ganta S et al. (2009) Formulation and pharmacokinetic evaluation of an asulacrine nanocrystalline suspension for intravenous delivery. International Journal of Pharmaceutics. 367(1-2):179-186.
5. Mouton J W et al. (2006) Pharmacokinetics of itraconazole and hydroxyitraconazole in healthy subjects after single and multiple doses of a novel formulation. Antimicrobial Agents and Chemotherapy. 50(12):4096-4102.

Biography

Lorenz De Neve started his carrier as a Researcher with his master thesis on the sorption behavior of cationic surfactants. During this period he obtained experience concerning the preparation and characterization of liposomal dispersions, including viscometry using rotational viscometers, submicron particle sizing by dynamic light scattering and adsorption analysis by both QCM-D and by the traditional depletion technique. Currently he is conducting research on pharmaceutical nanosuspension formulations. More specifically the purpose of his research is to enlarge the fundamental knowledge of the link between the formulation parameters and the macroscopic properties of nanosuspensions and to understand the interactions between the different formulation parameters.

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