Enhanced electrical properties of insulating materials containing nanoscale filler particles (nanocomposites) are attributed to an interfacial area that is formed between the polymer matrix of the base material and the filler particles. So far the interfacial area could not be made visible. The two materials investigated in this study are based on the same silicone matrix material and either contain filler particles of the type F1 or filler particles of the type F2, both of them having nearly the same primary particle diameter. Differences in the electrical properties of the two materials are interpreted by an interfacial area that is larger around filler particles of the type F1 than around filler particles of the type F2. To gain an insight into the interfacial area the two materials were investigated by Atomic Force Microscopy (AFM) and Electric Force Microscopy (EFM). In the EFM images the both types of filler particles appear larger in the composite material than they do when they are not embedded in the composite material. This difference is explained by an interfacial area that surrounds both types of filler particles if they are embedded in the base material. As the particles of the type F1 appear significantly larger than the particles of the type F2 in the EFM images it can be concluded that the interfacial area around the filler particles of the type F1 is larger than the interfacial area around the filler particles of the type F2. By the combination of electrical measurements, their interpretation
with models and AFM and EFM measurements the existence of the interfacial area in the investigated nanocomposites could be proven. The measurement results also give a hint on the nature of the interfacial area which could either be charge carriers forming an electrical double layer around the nanoparticles or a change in morphology of the polymer surrounding the particles by polymer-filler interaction resulting in a change of permittivity of the surrounding polymer region. Most notably the interfacial area could be made visible by EFM measurements.

Stichworte: Nanocomposites, interphase, atomic force microscopy, polymers, filler particles

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