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The nanoscale

ABSTRACT. In order to overcome the intrinsic arbitrariness of current definitions of the nanoscale, a phenomenological approach is taken, in which the nanoscale is defined as the length at which a sharp transition between typical bulk and nonbulk behaviour occurs. The nanoscale then becomes property-dependent, and in many cases will also depend on parameters such as temperature. On the other hand, the nanoscale then truly becomes a domain in which novel and unique properties are observable, which is very often not the case under the currently widespread, yet highly provisional, definition of "below 100 nm" (for which there is no real conceptual basis). It is not necessary for the transition to be discontinuous in the sense of a phase transition, it might be a crossover between two distinct types of behaviour. By the same token, properties changing monotonically and continuously with size cannot provide a nonarbitrary definition of the nanoscale. We consider electrical, magnetic, optical and mechanical properties, first of materials, and then of devices, for which we also consider fluidics. Because of the rather wide compass of properties, we cannot go into great depth in considering them all, and expect that further refinement will take place in the future.

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