Editorial

Professor Günter Petzow proposed a diagram that shows the probability of the formation of new substances from the combination of the available elements (Max-Planck-Gesellschaft Spiegel, 5/95, p 46). The possible theoretical substances sum up to 10^{24}. The known phases and compounds are only a small fraction of the possible combination of the elements, much like the exterior of an iceberg floating on the ocean. Petzow called this diagram a "constitutionberg." It provides an impressive demonstration of our lack of knowledge. It is true that we have reached an important understanding of the binary phase diagrams. We have already started the evaluation and the compilation of the ternary diagrams. Those are the major results of the Alloy Phase Diagram Program that has been operating for years. However, Petzow's "constitutionberg" indicates that they are just a scratch on the huge iceberg that floats on the Unknown Ocean.

Most phase diagram determinations assume stable equilibrium at their working conditions. However, if a phase does not easily decompose or transform into new phases, we can determine a metastable phase diagram. These are certainly the most important phase diagrams for industry, but they bring the complexity of time evolution since kinetic phenomena will be present. Hence, time is an essential parameter for the correct application of metastable phase diagrams. So either the metastable phase diagram is empirically determined as a function of time, or the actual kinetic mechanisms are incorporated into the description of the system.

The C-Fe system provides perhaps the most well-known metastable phase diagram with the formation of cementite instead of graphite. Its usefulness is well documented. Its experimental determination is not difficult since the stability of the cementite is very high. This is an extreme case, but there are other systems where the stability is not so clear. The composition range of amorphous metallic alloys depends very much on the elaboration process, so we infer that kinetic constraints are important. Solid-state interdiffusion in multilayer thin films and mechanical alloying provides different paths to new metastable phases. From these examples, we propose the following questions. Are we able to incorporate a time scale into the phase diagram? Is it possible to provide consistent metastable phase diagrams?

TTT diagrams provide a partial answer to these questions, but how can we extend it to the different elaboration process? The solution to these questions will widen our knowledge in materials science and will be very valuable for the industry and the development of technological materials.

R.R. de Avillez
Associate Editor
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