3.7. Sequence of compound-layer formation at the *A*–*B* interface

From a theoretical viewpoint, predicting the sequence of layer occurrence at the *A*–*B* interface would present no difficulties if the values of all the chemical constants entering a system of differential equations like (3.27) were known. For any multiphase binary system *A*–*B*, these values are determined by the physical-chemical properties of the elements *A* and *B* and their compounds. With their dependence on those properties established, the sequence of formation of compound layers would readily be predicted from the system of equations (3.27) or similar. Unfortunately, the theory of reaction diffusion has not yet reached this stage of its development.

It is obvious that simultaneous occurrence of all compound layers at the *A*–*B* interface is highly unlikely since even with three compounds the total probability of the cases where the derivatives d*x*/d*t*, d*y*/d*t* and d*z*/d*t* have different signs (+,–,–; –,+,–; –,–,+; +,+,–; +,–,+; –,+,+) is evidently much greater than the probability of the case in which all three derivatives are positive (+,+,+), with their ratio being 6:1. Therefore, from a physicochemical viewpoint, formation of the A_pB_q, A_rB_s and A_lB_n layers must be sequential, rather than simultaneous, in accordance with experimental observations.

Exact laws governing the sequence of occurrence of compound layers in a particular reaction couple have not so far been established. What is available is a few empirical rules predicting this sequence at a probability level of about 60 to 90 %. These are based either (*i*) on the structure of the equilibrium phase diagram of a binary system or (*ii*) on the thermodynamic properties of its compounds.

3.7.1. Phase-diagram predictions

The equilibrium phase diagram is doubtless the main source from which the researcher obtains the required primary data, when starting to investigate the kinetics of formation of chemical compound layers in a particular binary system. It immeaditely indicates which compounds *may* form separate layers but by no means dictates that those must occur at *A*–*B* interface simultaneously.

In the case of binary systems with three or more compounds, generally there is no full correspondence between the microstructure of the *A*–*B* transition zone and the appropriate equilibrium phase diagram, whatever the annealing time. Part of compounds