V. I. Syutkina. *New hardening mechanisms of ordered alloys.* Modern industry has a great need for alloys with combinations of optimum properties. Development of such alloys is especially difficult. There is much room for improvement of the physicomechanical properties of alloys by using phase transformations, among which atomic ordering occupies a special position, primarily because many properties of the alloy (electrical, thermal, magnetic, mechanical, corrosion, etc.) change simultaneously on establishment of long-range order in the disposition of the various atomic species. This alone can provide a basis for development of alloys with given sets of properties. However, extensive industrial use of ordered alloys is being held up by their unsatisfactory mechanical properties: they are either not strong enough or very brittle.

Institute of Metal Physics studies of the system of gold-copper alloys have shown that it is possible to produce high-strength ordered alloys with a number of optimum properties, combinations that are stable over broad temperature ranges. It has been proposed that domain boundaries be used to strengthen the alloys.[1,2] For domain boundaries to be decisive in improving the strength characteristics of Cu_3Au-type alloys, it is necessary to combine two phase transitions in the alloy: atomic ordering and decay of a supersaturated solid solution. When these processes are brought about simultaneously, the grain boundaries become sites of heterogeneous nucleation of a precipitating phase. By varying the amount and species of the alloying additive and the dimension of the domain-boundary volume grid it is possible to modify the mechanical properties of the ordered alloy over very wide ranges. For example, the yield point can be raised from 60 to 780 MPa by alloying with silver. Such alloys have already qualified as high-strength materials.

A periodic antiphase domain structure with a period ranging from 2 to 20 lattice constants can be formed by special alloying of Cu_3Au. The density of the domain boundaries is especially high in such alloys. Periodic antiphase domain boundaries may also be sites of heterogeneous nucleation of a precipitating phase.[3] Structures of this type may be interesting not only for development of high-strength alloys, but also for that of special magnetic alloys that have antiferromagnetic segregations in a ferromagnetic matrix or ferromagnetic-phase segregations in an antiferromagnetic surrounding. It is possible that structures in which superconducting and nonsuperconducting interlayers alternate in strictly regular fashion, at intervals of a few lattice parameters, may be interesting for the development of superconducting materials.

The strength properties of equiatomic alloys of the CuAu type can be raised by domain-boundary hardening without additional alloying. The highly distinctive ordering of atoms of different species in ordered alloys of equiatomic composition complicates domain structure. Domain boundaries at which atoms of different species are arranged in mutually perpendicular layers make their appearance in addition to the antiphase domain boundaries. High-strength ordered alloys with yield points of 730–830 MPa can be obtained by refining the domain structure. These alloys retain the entire combination of optimum properties inherent to the ordered state, and are useful in solving many contemporary instrumentation problems. With supplementary alloying and combined atomic-ordering and solid-solution-decay strengthening, it is possible to raise the yield point to 1300 MPa.[1] Alloys of this type offer the greatest promise for the development of high-strength ordered alloys.

[1] V. I. Syutkina, L. P. Yasyreva, and R. Z. Abdulov, Fiz. Met. Metalloved. **53**, 385 (1982).

[2] V. I. Syutkina, O. D. Shashkov, V. K. Rudenko, and I. E. Kislitsyna, Ukr. Fiz. Zh. (1982).

[3] V. D. Sukhanov, O. D. Shashkov, and V. I. Syutkina, Fiz. Met. Metalloved. **49**, 1267 (1980).