NEW RADIATION TECHNOLOGIES AND METHODS FOR CONTROL OF TECHNOLOGICAL PROCESSES IN METALLURGY

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Investigations of metal properties modification by ionizing irradiation conducted in Radiation Physics Laboratory for years showed that the most promising are the following trends in development of metals and alloys radiation processing methods that make possible to rise radiation technologies efficiency many times and to make expedient their large-scale application in metallurgy industry:
Combination of radiation processing with mechanic, thermal or thermal and chemical treatment; Application of such technologic approaches when metals and alloys are not directly subjected to processing but the initial materials necessary for their production are processed instead. Radiation technologies development should be accompanied by the improvement of technologic processes control methods. High informant abilities and responsibilities to micro-structure and micro- composition changes due to irradiation should be inherent to applied control methods. In particular the internal friction method developed in the laboratory conformably to irradiated metals and alloys defect structure studies is up to the requirements.

Radiation Technology of Metal and Ceramic Production with Enhanced Service Properties. Based on application of radiation technique in powder metallurgy the new technology for obtaining metals, alloys and ceramic materials with high service properties is worked out. Radiation processing of powder materials at the certain stage of the process leads to profound structure alterations at all further stages and eventually effects the properties of the resulting product. Theoretical calculation and experimental studies of electron-positron annihilation in powder-pressed samples showed that irradiation caused powder particles surface state changes favorable for further sintering and crystallization processes development. It is shown that irradiation of metal powders and powder-pressed samples by high energy electrons is technologically most efficient. The right choice of the type and the mode of the radiation processing makes it possible to obtain metals, alloys and ceramic materials (Mo,Fe, W, Al, Ni, Cu, stainless steels, ceramics, etc.) with homogeneous structure and stable enhanced service properties.

The project on radiation technology application to powder metallurgy represented by a group of authors was awarded with the diploma and the gold medal at the 22 International Exhibition of Inventions (Geneva, 1994).

New Technologic Opportunities of the Cromium-Nikel Alloys Processing To obtain the required phase-structure state special methods of the chromium-nickel alloy processing for sensitive elastic devices production were worked out combining plastic deformation, thermal and radiation processing. It is shown that h-gвв phase transfer not observed before is possible in extremely non-equilibrium conditions under electron irradiation. It is established that the complex reaction of recrystallization and gв-phase deposition proceeds under electron irradiation at the room temperature when the certain threshold plastic deformation degree is reached that leads to the same effect that the long-time aging of deformed samples at high temperatures. The

observed effect of elastic module temperature stabilization under electron irradiation is especially important for elastic devices service properties improvement.

Non-Traditional Internal Friction Method Applications for the Control of the Structure-Phase State and Defects in Metals and Alloys Modern macroscopic theory of internal friction is developed as the base of experiment and technology control methods and experimental data analysis. The principals of internal friction data spectroscopic analysis are elaborated. New physical information is obtained on special distribution, diffusion and vibration spectra of impurities and defects in irradiated metals and alloys. It is shown that electron irradiation can be used to influence upon atom vibration spectra.

The revealed behavior of internal friction in irradiated metals and alloys and developed methods of internal friction spectroscopic applications can be successfully used for material science and technologic purposes and contribute to non-destructive diagnostics of radiation and other defects in metal systems.

References

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