surface and the transport in the gas phase may be neglected. Different models describing the mass transfer from the interior of the melt to the interface are also discussed. The course of degassing of a melt pool without bubble formation, based on the mathematical treatments of Kraus and Machlin is described.
O Winkler, *J Vac Sci Technol,* 7 (6), *Nov/Dec* 1970, *S*14–*S*21.

37

1209. Kinetics and thermodynamics in continuous electron-beam evaporation of binary alloys. (USA)*
Continuous electron-beam evaporation of binary alloys was studied. Silver–copper wires with 5, 10, 20, and 30 at. per cent of silver were fed into an evaporation source which was heated by an electron beam. Beam powers up to 4.5 kW were used and evaporation temperatures from 1625–1960 K were obtained. Methods were developed to study mass and composition distribution of the vapour flux, the transient period, and the steady-state conditions.
T Santala and C M Adams, *J Vac Sci Technol,* 7 (6), *Nov/Dec* 1970, *S*22–*S*29.

37

1210. Computer simulation in metals research. (USA)*
The role of computers in applied research is discussed. Computer simulation is considered as a new set of mathematical techniques which augments and goes beyond the older analytic techniques. The major challenge of simulation methods is scientific rather than computational in the selection of models to represent a physical process. Models are discussed in the context of the problems of applied science.
W Oldfield, *J Vac Sci Technol,* 7 (6), *Nov/Dec* 1970, *S*30–*S*35.

37

1211. Vacuum heat treating using plasma EB. (USA)*
A semicontinuous heat treatment equipment and some of its operating results for metal strips or foils are described. Work accelerated electron flux from a hot hollow cathode discharge is used for bombarding the strip. Homogeneous thermal history, rapid heating cycle, and a very high temperature processing are obtainable by using an electron bombardment heating for running strips. Processing of metal strips while running will also be desirable for high temperature treatment where adhesion between layers of a roll may cause defects.
H Takei and Y Yoneda, *J Vac Sci Technol,* 7 (6), *Nov/Dec* 1970, *S*36–*S*38.

37

1212. Vapour deposition by liquid phase sputtering. (USA)*
Liquid binary alloy targets have been sputtered at ion densities of up to 100 W/cm^2 providing deposition rates in excess of 10 mils/h in a combined sputtering–evaporation mode. At high power densities a self-sputtering mode has been demonstrated which allows deposition from 10^{-7} to 10^{-2} torr. Comparison of sputtered deposit compositions of Pb–24 In, Fe–30 V and Fe–32 Ni with theoretical molar ratios predicted on the basis of thermal vapourization shows that alloy fractionation is substantially reduced.
R C Krutenat and W R Gesick, *J Vac Sci Technol,* 7 (6), *Nov/Dec* 1970, *S*40–*S*44.

37 : 30

1213. Superconducting transition temperatures of vapour-deposited niobium nitride. (USA)*
Thin films of the superconducting compound niobium nitride were deposited at atmospheric pressure on fused silica substrates by reaction of gaseous pentachloride with ammonia and hydrogen gases in a fused silica apparatus. Suitable conditions for the preparation of NbN were found by calculating the free energies of reaction for several possible reactions involving niobium chlorides, ammonia, and hydrogen. Niobium nitride films could be formed at substrate temperature ranging from 900°–1000°C. The deposition rate varied with the reaction conditions from 20 to 1500 Å/sec, and deposits ranged from smooth films of polycrystals in which the individual crystal faces were 20 μ in length. The maximum transition temperature obtained was 15.75 K for the films deposited at 900°C.
G Oya and Y Onodera, *J Vac Sci Technol,* 7 (6), *Nov/Dec* 1970, *S*44–*S*47.

37

1214. Metallurgical characteristics of titanium-alloy foil prepared by electron-beam evaporation. (USA)*
The supersonic titanium aircraft has requirements for high-strength titanium-alloy foil for honeycomb structures. In conventional rolling of such alloys as titanium–6 per cent aluminium–4 per cent vanadium, multiple high-vacuum anneals are required to reach the thin-foil gauges, from 0.001–0.004 inch, used for honeycomb cores. The advantages of electron-beam evaporation and deposition in the desired thicknesses, and without rolling and multiple vacuum annealing, are studied. All metallurgical characteristics of EB evaporated foils appear to be suitable for the intended end uses. Evaluations in the form of actual honeycomb structures are underway.
H R Smith et al, *J Vac Sci Technol,* 7 (6), *Nov/Dec* 1970, *S*48–*S*51.

37

1215. Vapour generation and deposition of zinc at high rates. (USA)*
A system for zinc vapour generation and deposition onto a strip substrate at high rates is described. A resistance heated graphite crucible with a special design to suppress uncontrolled boiling is able to produce zinc vapour outputs as high as 150 lb/h for the 300 in.^{2} hearth area utilized. An efficient system for nozzling the zinc vapour onto the strip substrate from an enclosed hood allows this maximum vapourization rate to be condensed uniformly at a thickness of 0.6 mils across a 12-in. width at a line speed of 100 ft/min. Control of the vapourization rate is obtained through variation in the power input according to a heat flow model and also by means of a barometric liquid-zinc leg which is used to fill and empty the crucible and feed it continuously from outside the vacuum chamber. Other methods used to control the system are also discussed briefly as is the type of coating produced by deposition at these high rates.
J F Butler, *J Vac Sci Technol,* 7 (6), *Nov/Dec* 1970, *S*52–*S*56.

37 : 30

1216. Formation of superconducting Nb_3Al and Nb_3Al-Ge films. (USA)*
The formation of Nb_3Al or Nb_3Al–Ge compounds on niobium substrates is described. The film formation was followed using optical microscopy and x-ray diffraction techniques. Electrical resistance measurements at cryogenic temperatures were obtained to determine critical transition temperature for superconductivity. The films were prepared by three processes: (a) dipping the Nb substrate into an Al–Ge melt contained in a graphite crucible, holding for several seconds followed by a thermal diffusion treatment; (b) vacuum deposition of Al or Al–Ge on Nb followed by heat treatment similar to that in (a). The advantage of vacuum deposition is better control of the film thickness of Al or Al–Ge; and (c) simultaneous deposition of Nb and Al on Nb substrates in vacuum. The deposition rate of Nb and Al was controlled at a 3:1 atomic ratio. Germanium was simultaneously deposited with Al.
A Isao et al, *J Vac Sci Technol,* 7 (6), *Nov/Dec* 1970, *S*57–*S*62.

37

1217. Theory and practice of electroslag melting. (USA)*
The mechanisms of heat transfer and heat generation in an electroslag process are considered and related to operating characteristics of the process. It is concluded that the form of heat transfer in the slag/mold wall region has a profound effect on the ingot surface. Also, it is noted that the presence of the slag layer has an over-all effect on the heat balance which accounts for the shallow ingot pool-profiles found in ESR ingots. The nature of chemical reactions in the electroslag process is briefly discussed in relation to the oxygen content of ESR ingots. Finally, the synergistic character of ESR process parameters is illustrated by considering the effect of power variations on the ingot solidification pattern.
A Mitchell, *J Vac Sci Technol,* 7 (6), *Nov/Dec* 1970, *S*63–*S*73.

37

1218. Purification of vanadium by vacuum melting. (USA)*
The Bureau of Mines compared the purification of two commercially available vanadium samples by three vacuum melting techniques: consumable-electrode arc melting in a conventional deep mould, consumable-electrode arc melting at the top of the mould, and conventional electron-beam melting. Top-of-the-mould (TOM) and electron-beam (EBF) melts were both conducted in the same vessel equipped with a bottom-withdrawal mechanism. Pressures during melting were in the range of 0.10–0.50 mtorr; the pressure in the deep mould could not be measured, but probably exceeded 100–300 mtorr during a typical melt. Arc melting was characterized by melting rates of 500–800 g/min, but electron-beam melts were limited to rates of 20–30 g/min. Forty-nine per cent of the oxygen content was removed by double melting vanadium sponge at the top of the mould, and 42 per cent of the oxygen content was removed from electrorefined vanadium treated in the same manner; however, the carbon and nitrogen increased. The purity of samples melted at the TOM approached the purity of samples prepared in the EBF.
W E Anable, *J Vac Sci Technol,* 7 (6), *Nov/Dec* 1970, *S*74–*S*81.