Opinion

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Relation between Low Melting Point Phases and Liquation Cracks

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Description

Eliminating flaws in the laser melting and additive manufacturing technologies depends heavily on the alloy design. During the Laser Melting Process (LMP), liquidation cracks are thought to originate from the low melting-point phases surrounding the grain boundaries. In order to comprehend the connection between the formation of liquidation cracks during the LMP and low-melting point phases, a straightforward Al-Cu binary alloy with varying concentrations of Cu was chosen as the model in this study. The majority of Al2Cu precipitate at the Al grain boundaries in cast samples, and liquidation cracks in the Laser Melted Zone (LMZ) began at the grain boundaries and spread along the LMZ during the LMP. As a result, homogenization annealing and pre-laser melting were performed at various times. The findings revealed that the cast Al-3.5Cu had a high susceptibility to cracks in the LMZ due to the presence of a lot of phases. However, during homogenization and annealing, the phases dissipated, which significantly reduced the number of cracks. Due to the presence of numerous equilibrium eutectic phases, which heal the cracks during the LMP's solidification, Al-7.5Cu exhibited no cracks under cast and homogenized conditions. The susceptibility of liquid cracks can be controlled through homogenization and annealing.

Effect of Hydrogen Production

The response of aluminum water to deliver hydrogen is forestalled by an alumina film. This paper examines the effect of various content and In–Sn ratios on the aluminum alloy's hydrogen production performance as well as the effect of hydrogen production at various temperatures in order to prepare a type of aluminum alloy with instant hydrogen production and high hydrogen yield. X-ray diffraction, differential scanning calorimetry, and the scanning electron microscope are used to examine the thermal properties in addition to the composition and structure. They appear as two intermetallic compounds, In_3Sn and $InSn_4$, with varying ratios of In and Sn. At the point when Ga, In, and Sn were added to aluminum together, the hydrolytic properties of the Al-Ga-In-Sn composites are extraordinarily gotten to the next level. In the end, the paper produced an aluminum alloy with activation energy of 39.2 kJ/mol and a hydrogen conversion rate of more than 98%. Hydrogen energy development and application are further encouraged. Due to its high thermal conductivity, low sputtering erosion, and high melting point, tungsten has been utilized as a Plasma Facing Material (PFM) in ITER. As a PFM, tungsten is exposed to radiation from hydrogen (H) and helium (He) ions as well as highly energetic neutrons. At fluxes of the order of the m2 s1, those ions in mixed H–He plasma are anticipated to have energies of up to 100 eV. W is thought to have a transient surface temperature of up to 3000 K, making helium irradiation in W a serious concern for fusion reactors. The retention and formation of helium clusters, dislocation loops, and fuzz on the tungsten surface as a result of the bombardment of helium ions reduce tungsten's mechanical properties embrittlement and hardness and thermal conductivity, which in turn significantly shorten the PFM's service life. One of the most significant issues in the finalization of fusion energy is the issue of plasma materials in Tokamak and future reactors. The introduction of tungsten into the plasma, which will accelerate the plasma's cooling as a result of ionization and braking radiation, is the most obvious cause of fuzz's concern. The physical properties of fluffy deposits are typically unstable, and they can frequently be removed by scraping or wiping with a cloth. As a result, dust formation in magnetic restraint devices has always been a concern for some researchers.

Linear Attenuation Coefficient

The radiation shielding capability of highly flexible, stretchable thermoplastic polyurethane composite that was loaded with a low-melting-point $Ga_1In_1Sn_7Bi_1$ multi principal element alloy was evaluated. The liquid attribute of LMPEA and the adaptability of TPU empower great point of interaction similarity. The liquid gallium-rich phases of Ga1In1Sn7Bi1 LMPEA are distributed at the boundary of the InBi intermetallic compound and Sn solid solution, and they are made up of two eutectic structures. LMPEA has a theoretical specific lead equivalent of 0.803 mmPb/mm and a theoretical weight reduction of 17.27% in comparison to lead in the low-photon energy range of 30–80 keV. The Phy-X procedure and Monte Carlo simulations were used to determine the shielding parameters, such as the mass attenuation coefficient, linear attenuation coefficient, half-value layer, tenth-value layer, mean free path, effective atomic number, and fast neutron removal cross section, in order to evaluate the photon attenuation capability of the LMPEA/TPU composites. The actual lead equivalent was measured during the X-ray protective material attenuation performance test. The LMPEA/TPU composite meets the lead equivalent requirements of X-ray protective clothing because it has a measured lead equivalent that is higher than that of the in-service medical shielding materials at the same thickness. Non-toxic, light, and excellent at shielding low-energy X-rays, LMPEA/TPU composites have great potential for use in medical wearable materials. Energy and environmental issues become increasingly prominent as the modern economy develops rapidly. Technology for thermal energy storage and management is crucial to maximizing energy efficiency and protecting the environment. Because they are able to absorb and release a significant amount of heat during a phase change process, thermal storage and management materials aid in maintaining the equilibrium between the demand for and supply of energy. As a result, they provide a wide range of applications for thermal energy management, including electric power, chemical engineering, building energy conservation, electronic devices, and chemical engineering. Materials for thermal energy storage and management with low melting points of 25–85 °C are thought to be a good choice for electronic device cooling in mid-low temperature systems. Organic thermal management materials made from n-eicosane, n-alkane tricosane, paraffin, and other materials were the primary focus of many researchers. Studied how the addition of expanded graphite affected the thermal properties of paraffin. They found that while the phase transition temperature did not change, the latent heat increased as the amount of dissolved state paraffin increased. Farzanehnia conducted an experiment using carbon nanotubes and paraffin as a thermal management unit and discovered that this material can improve the system's thermal control. Examined thermo physical properties of n-eicosane, and exploratory outcomes showed that n-eicosane with high dormant intensity could assimilate heat dissemination from the chips and can keep up with the chip temperature underneath suitable help temperature. In the meantime, additives with a high thermal conductivity are used to increase organic materials' thermal conductivity; however, over time, the thermal conductivity of these additives decreases. Due to their low thermal conductivity, organic materials cannot be used on a large scale.