Selective Phase Corrosion of Al-Cu Alloys to Fabricate Porous Metals

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Engineered porous materials possess large surface area. Of the many types of these materials, this research focuses on the study of porous metallic ones. Through alloys of noble metals (e.g., gold, silver, platinum) with less noble ones (e.g., aluminum, zinc, magnesium), porous metals have been manufactured successfully. This research hinges on the fabrication of low-cost porous metals, using aluminum and copper. The selected compositions for the Al-Cu system were Al-27.7wt% Cu and Al-37.7wt% Cu. This compositions upon solidification led dendrites of Al (the first composition) or Al2Cu, an intermetallic phase (the latter composition), as well as eutectic regions surrounding those dendrites. The implemented methodology includes: alloy melting and casting, sample preparation, annealing, selective corrosion, and characterization. Melting was completed at ~800°C and the melt was poured onto a Cu mold at the same temperature. The preparation of the samples included cutting 10x10x2mm samples and fine polishing (with 0.05 µm silica emulsion). Subsequently, an annealing treatment allowed to homogenize the chemical composition throughout the zones of the same phase. Sodium hydroxide (NaOH) was used to perform selective corrosion, removing the Al and leaving the intermetallic phase (Al2Cu) unaltered. To characterize the specimens, I used by x-ray diffraction, scanning electron microscopy and optical microscopy. The characterization demonstrated the effectiveness of the process and the possibility of measuring the porous and ligaments size, as well as the percentage of porosity of the sample. This research could work to create efficient batteries, energy storage systems, and biomedical devices.