tongued and grooved surfaces. In the future such ultra-light cores having these functional properties are expected to be developed. To meet the demand, simple but efficient core models have to be devised taking engineering processing into account. During the course of this research, fundamental core models based on space-filling models known in classical geometries were developed first, followed by sponge cores using the concept of skew polyhedra. Afterwards some modified models such as cylindrical cores or 3D honeycomb cores were developed based on these fundamental ones.

P36: Effects of Initial Microstructure and Microstructure Changes During Deformation on the Superplasticity of $\beta$-Type Titanium Alloy
I. KUBOKI, Shizuoka Institute of Science and Technology,
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Tensile tests for the Ti-15V-3Cr-3Sn-3Al, which is typical of $\beta$-Type Titanium Alloy, with different initial structures have been carried out at temperatures around $\beta$ transus. For specimens with relatively large initial grain sizes ranging between 15 and 170\,$\mu$m, the strain rate giving the maximum total elongation moves to higher values with decreasing grain size. The grain size exponent, 3, of initial grains in the Dorm equation for creep is about 0.5 for the present alloy, which is fairly small compared with the value of 2 or 3 usually obtained for the superplastic alloys with fine grain. When the Zener-Hollomon factor (Z = exp(Q/RT)) is the same, the size of subgrain developed by the deformation is nearly the same with each other irrespective of the initial grain size. When the initial grain size is almost the same with the subgrain size induced by the deformation, the maximum total elongation as large as 400\% is obtained by present study. Flow stresses depend on both the initial grain size and subgrain size. The grain size exponent, $p'$, of the subgrains is nearly 0.5 as well as that of initial grains, independently of initial structures. An increase in the misorientation angle between subgrains of the alloy in a $\beta$ phase state is possibly due to the coalescence of the subgrains, which is followed by the continuous recrystallization without grain boundary migration.

Poster Session and Coffee Break

10:15 a.m. - 11:00 a.m.
PLENARY LECTURE II

Manufacturing at Multi-Scales
J. CAO, Northwestern University,
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Manufacturing as a backbone to advancing the living standard of a nation has recently experienced some ups and downs in different regions. Researchers in the area of manufacturing contribute to nation’s growth, meanwhile also to the decreasing demand of labors.

This talk aims to present challenges for researchers in manufacturing across different scales: size wise from macro-manufacturing to nano-manufacturing, method wise from experiments to simulations, process wise from additive manufacturing to zero-waste, material wise from polymer to multi-phase metals, discipline wise from material characterization to metrology, application wise from auto to bio, design wise from deterministic design to design under uncertainty, policy wise from specific research topics to broader manufacturing research planning strategy. Selective state-of-the-art research results will be presented briefly, in addition to the overarching view of the above topics, to address the depth of manufacturing research.

The essential message of this talk is that researchers in the area of design and manufacturing have to work collaboratively and effectively, especially under the current tight funding situations. Many programs across the National Science Foundation require a critical mass to bring noticeable funding to the community. With the mind of creation, determination and collaboration, the future success of manufacturing research is in everyone’s hand.

DISCLAIMER: The view presented in this paper/talk is of the author’s personal view, does not represent the policy of the National Science Foundation.

11:15 a.m. - 12:00 noon
Room A
Keynote I

Development of High-Strain and Durable Air-Stable Ionomeric Polymer Transducers
D.J. LEO, B. AKLE, M. BENNETT, Virginia Polytechnic Institute and State University,
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Electroactive polymer materials are a class of active material that exhibits large deformation upon the application of an electric field. There are several classes of electroactive polymers, including conductive polymers, dielectric elastomers, high-strain piezoelectric materials, and electroactive polymers based on carbon nanotubes. Over the past several years our research group has focused on the development of a class of ionomeric polymer transducers, also called ionic polymer-metal composites (IPMCs), that exhibit large bending deflections upon the application of low (<10 V) voltage. This paper will overview our recent advances in the characterization and development of high-strain actuators using ionomeric polymers. Our results demonstrate that electromechanical actuators capable of bending strains on the order of 2\% to almost 10\% are possible by tailoring the properties of the polymer-metal interface. The mechanical deflection is strongly related to the charge accumulation at the interface, and the strain rate of the material is strongly correlated with the conductivity properties of the membrane.