Equiatomic or near-equatomic multicomponent alloys, often termed as high-entropy alloys (HEAs), are an emerging class of metallic materials that are being investigated for a wide range of technical applications. Most studies have been focused on optimizing microstructures or mechanical properties of HEAs and relatively few have designed an alloy for investigating corrosion behavior of HEAs. This study describes the microstructural and corrosion behavior together with mechanical properties of six HEAs that were designed with the intent to provide high corrosion resistance whilst offering the possibility for high temperature applications. The basic components of the alloys are composed of five elements that are commonly used in high-temperature alloys, Fe, Cr, Ni, Mn and Co. A sixth element, Al, was also added. Another element that had been selected as the alloying elements, particularly due to their remarkable properties were Zr, Ta and Sc. Detailed microstructural and chemical analysis have confirmed the presence of the expected BCC and FCC solid solution phases, however, the minority phases in all of the alloys were found to be ordered intermetallics. The hardness investigation demonstrated that the hardness values increased gradually for all alloys due to the formation of the intermetallic compounds. The FeCrNiMnCo alloy density reached up to 8.056 g/cm³ meanwhile the introduction of Al to the alloy apparently reduced the density to 7.533 g/cm³. The enhancement of Ta to the high-entropy alloys has improved the densification of the systems caused by the higher density of Ta atom amongst other constituent elements. FeCrNiMnCoTa6.6 alloy reached the highest density up to 9.455 g/cm³. The increase of Zr and Ta content has lowered the thermal stability of the systems whereas Sc alloying has showed vice versa. Electrochemical study revealed that all elemental additions significantly increased the corrosion resistance. The comprehensive atomic radius, the mixing enthalpy, ΔHmix and the mixing entropy ΔSmix of alloys were also calculated according to relevant equations using the phase selection rules. Collectively, these results have confirmed that complex multicomponent HEAs can be designed and processed using the existing phase selection rules. These results also reiterated the need for refinement of the phase selection rules for HEA formation and improved thermodynamic databases to facilitate the design of better HEAs.

Bamboo has great potential to be utilized for various purposes. It has always been associated with traditional way of Malaysian rural lifestyle. Nevertheless, time is changing and sustainability issue has increased the popularity of bamboo as sustainable material for many purposes. It is mostly derived from non-renewable resources nowadays. The aims of current study were, (1) to evaluate the physicochemical characteristics of four Malaysian bamboo species that is Semantan (Gigantochloa scortechinii), Beting (Gigantochloa levis), Lemang (Schizostachyum brachylyadum) and Akar (Bambusa vulgaris) (2) to determine the properties lignin extracted from Malaysian bamboo and subsequently (3) to develop lignin phenol formaldehyde adhesive resins and characterize its physical, chemical and mechanical properties. Lignin was obtained from bamboo via soda pulp method using autoclave at elevated temperature and pressure. For the synthesis of lignin phenol formaldehyde, two types of bamboo lignin namely Semantan and Beting bamboo were chosen with percentage of lignin to phenol replacement were 5%, 10%, 15% and 20%. Results indicated that there was little variation in terms of extractive and major chemical composition regardless of differences in terms of species studied although there were significant differences in Et-OH extractive content, holocellulose and alpha-cellulose content among Malaysian bamboo studied. The ash content value of Malaysian bamboo is 5.43% to 8.50%. Malaysian bamboo has fiber crystallinity of 44.4%, 43.2%, 42% and 43.3% respectively for Semantan, Beting, Lemang, and Akar. Three major ash forming elemental composition was potassium (K), calcium (Ca) and magnesium (Mg). All bamboo lignin exhibit high degree of similarity to each other in terms of functional groups that exist. Bamboo lignin mainly composed of Guaiacyl (G) and Syringyl (S) type lignin. The thermal study shows that bamboo has generally low glass temperature (Tg) and high stability at high temperature (800°C). In the final part of this study, lignin-phenol-formaldehyde (LPF) adhesive resin was synthesized in laboratory using Semantan and Beting lignin. The physical, chemical and mechanical properties of the LPF were characterized and compared with the pure phenol formaldehyde (PF) used as control. Results obtained in this study revealed the potential of bamboo lignin as partial replacement of phenol in the synthesis of PF adhesives without compromising the properties of adhesives. Both PF and lignin phenol formaldehyde have comparable physical properties with high similarity in terms of functional groups that exist. Incorporation of lignin as partial phenol replacement was found to increase the viscosity faster over time compared to pure PF. Mechanical characterization based on dry lap shear strength indicated that all LPF yield satisfactory results surpassed the requirement for relevant International Standard such as Chinese National Standard (GB/T 14732). Results obtained in this study manifest the potential of bamboo lignin as partial replacement of phenol during the synthesis of PF adhesives without compromising the properties of adhesives itself. This research has touch some critical subjects on bamboo that contributes to the significant comprehensive understanding in terms of properties of the selected Malaysian bamboo and subsequently the properties of lignin from bamboo and its application in bio based green adhesives.