Phase changes and weldability of dissimilar copper-steel joints for a thrust rocket chamber

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The thrust chamber of the L75 liquid propelled rocket engine is composed of a copper chrome alloy, C18200 class. On the other hand, the outer compound responsible for heat extraction, called cooling jacket, is made of AISI 316L stainless steel. With respect to the manufacturing process, the union between the combustion chamber and the cooling jacket is a critical step since involves the joining of dissimilar materials and complex geometry components. In preliminary studies of arc welded components, the tensile strength of the weldment was only 15% of the strength of the C18200 class. Although the weld was absent of welding defects, such as cracks and porosities, something happens in the steel-copper joint. This work aims to contribute to the manufacture practice of the rocket motor assembly, by means of laser welding between the camera and the jacket. With the use of a fiber laser was possible to verify that there is an optimal condition of overlay welds of stainless steel on Cu(Cr). The experimental procedure aimed to understand the influence of three variables: laser speeds of 0.5 and 1 m/min; laser power from 1200 to 1800 W and pulsed and continuous wave mode. The welds have been always steel over copper because of the chamber geometry and the high reflectivity of copper to the laser radiation. Therefore, the weld chemistry is much depends on the partial dissolution of Cu in the steel melt. The primary effect of copper is to reduce the amount of austenite in the weld, and thus both austenite and ferrite appears in the X-ray diffractometry. The rapid cooling of laser welding produced two well marked zones, one rich and one poor in Cu. Although the observed microstructural heterogeneity, it was obtained almost constant hardness levels along the depth of the joint.