

Metal additive manufacturing for the marine industry: Opportunities, challenges, and outlook

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ABSTRACT

Additive manufacturing (AM) techniques have recently gained much attention in different industries including medical, aerospace, energy, and defence. This is mainly due to several advantages that these methods present including shorter lead time and fewer design complications. Of particular interest is metal additive manufacturing techniques that compared to conventional counterparts offer improved mechanical properties due to hierarchical and ultrafine microstructures resulting from high solidification rates. AM has not yet received enough recognition in the marine sector (specifically shipbuilding) due to some challenges. More shipbuilding and ship repair contracts have been granted in recent years in Canada and more offshore oil and gas exploration projects have been initiated lately in North America. These new projects are the driving force to implement new technologies including AM, cyber physical systems, machine learning, and automation in the next generation of marine products. Some of the challenges with the adoption of AM in the marine sector are lack of certification procedures, the absence of reliable large volume AM production platforms, and access to trained highly qualified personnel. In addition, there is a huge interest to conduct scientific practices (including multiscale modeling, electron microscopy, and in-situ monitoring) to implement AM parts in the marine sector due to increasing requirements for superior mechanical, corrosion, fatigue, and impact properties in this sector. An overview of these opportunities and challenges along with an outlook of AM in the marine sector in Canada is presented.