熱變形參數對粗晶A6061鋁合金超塑性行為研究

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摘 要

超塑性成形對於形狀複雜之工件可一次加工完成，免除諸多切削加工、熱處理、塑性加工與接合等傳統製程所造成的加工成本，並能達到高精密度的產品。目前，國外在航太與汽車等工業應用本技術已有製造成功各種零組件之案例，成為重要的精密加工技術之一。超塑性鋁合金材料以細晶(小於10μm)之A5XXX與A7XXX系列為主。本研究以容易取得之A6061大晶粒(約100μm)商業級鋁合金，希望能降低產業成本。實驗採以應變速率範圍0.01 s-1≧?≧0.0001 s-1及高溫範圍580℃≧T≧400℃進行壓縮與拉伸之變形試驗，藉以模擬與實驗驗證大晶粒鋁合金之超塑性所需要的操作參數。實驗結果顯示：熱壓變形為流變應力與溫度作用導致材料結構轉變，產生動態再結晶而達到晶粒細化之效果。高溫拉伸顯示溫度在550℃以上有較佳的延伸率，580℃時延伸率接近50%。壓縮及拉伸顯示580℃有最佳再結晶效果及高延伸率，因此以580℃為高溫脹形試驗溫度，得到110%膨脹率，使大晶粒鋁合金也具有超塑性行為。TEM顯示拉伸及壓縮試驗皆有動態再結晶產生，拉伸試驗不明顯。580℃高溫脹形能清楚觀察到次晶界生成及成長，顯示大晶粒A6061高溫脹形能藉由動態再結晶產生超塑性行為。

關鍵詞 : 鋁合金、大晶粒、動態再結晶、超塑性成形、高溫變形

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