# البحث الخامس

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**Abstract**

Jet impingement cold plates (CPs) are modern cooling modules increasingly used in emerging industries such as the electric vehicle market. However, the existing designs are not necessarily friendly to metal additive manufacturing. In this study, a compact and highly efficient mm-scale jet impingement cooling module is introduced and numerically characterized using ANSYS Fluent (2020 R[1]) through a range of flow rates. Hence, this study proposes four novel CPs with such considerations. CP1 to CP3 are all dual-chamber CPs, with CP2 being equipped with jet extensions and CP3 having a curved baffle to deflect the flow around the last jet array. Meanwhile, CP4 is a triple-chamber CP with an interspersed fluid extraction scheme. A computational model is developed to characterize the CPs' performances at flow rates between 0.212 and 2.121 LPM. The results showed that CP4 has the lowest pressure drop (37.36 kPa at 2.121 LPM). However, CP3 was superior in terms of almost all thermal performance aspects. CP3 registered the lowest average temperatures of the heated surface (326.5 K at 2.121 LPM), the lowest peak temperature of the solid domain (336.4 K at 2.121 LPM), the highest temperature uniformity index at the flow rate (0.9915), and the lowest average thermal resistance (0.042 K/W at 2.121 LPM). Overall, the results indicate promising potential for enhancing the cooling effectiveness by manipulating the flow architecture for restricted flow rates.