Laser cladding on grey cast iron at high power processing was investigated for microstructural evolution and phase transformation to enhance surface properties. Cladding was designed using a mixture of DOE with peak power (Pp) and pulse repetition frequency (PRF), and a mixture component of Cr and Mo ratio as factors. Microstructural findings indicated absolute elimination of graphite phase from the clad zone, in conjunction with particles evolution occurrence. Meanwhile, Cr, Mo and Fe phases were detected on the clad surface, along with M-C carbide, retained austenite and MoFe formation. The clad surface with addition of Mo exhibited a high hardness value of 945.5 HV₀.₁ due to carbide formation. As a result of high peak power penetration into substrate surface, the depth range of clad zone was 53 to 131 µm. From the optimisation, the highest desirability is 82.3 %. Cladding with molybdenum powder addition was found to have produced minimum surface roughness, maximum depth and hardness of 9.14 µm, 110 µm and 891.1 HV₀.₁, respectively.