Superconductivity of Ba$\text{8Si}_{46-x}\text{Ga}_x$ clathrates$^1$ YANG LI, Department of General Engineering, University of Puerto Rico at Mayaguez, PR 00681, USA, RUIHONG ZHANG, NING CHEN, XINGQIAO MA, GUOHUI CAO, Department of Physics, University of Science and Technology Beijing, 100083, China, Z.P. LUO, C.R. HU, JOSEPH H. ROSS, JR., Department of Physics, Texas A&M University, College Station, TX 77843 — We have presented a combined experimental and theoretical study of the effect of Gallium substitution on the superconductivity of the type I clathrate Ba$\text{8Si}_{46-x}\text{Ga}_x$. In Ga-doped clathrates, the Ga state is found to be strongly hybridized with the cage conduction-band state. Ga substitution results in a shift toward to a lower energy, a decrease of density of states at Fermi level, a lowering of the carrier concentration and a breakage of integrity of the sp$^3$ hybridized networks. These play key roles in the suppression of superconductivity. For Ba$\text{8Si}_{40}\text{Ga}_6$, the onset of the superconducting transition occurs at $T_c=3.3$ K. The investigation of the magnetic superconducting state shows that Ba$\text{8Si}_{40}\text{Ga}_6$ is a type II superconductor. The critical magnetic fields were measured to be $H_{c1}=35$ Oe and $H_{c2}=8.5$ kOe. Our estimate of the electron-phonon coupling reveals that Ba$\text{8Si}_{40}\text{Ga}_6$ is a moderate phonon-mediated BCS superconductor.

$^1$UPRM-CID seed program (Grant No. SM-07-14), National Natural Science Foundation of China (Grant No.50372005) and Welch Foundation (Grant No. A-1526).