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Superconductivity in the Zintl intermetallic compound $Ca_{11}Bi_{10-x}$ MIHAI STURZA, HAN FEI, CHRISTOS MALLIAKAS, HELMUT CLAUS, DUCK YOUNG CHUNG, Argonne National Laboratory, MERCOURI KANATZIDIS, Department of Chemistry, Northwestern University, MATERIALS SCIENCE DIVISION, ARGONNE NATIONAL LABORATORY TEAM, DEPARTMENT OF CHEMISTRY, NORTHWESTERN UNIVERSITY COLLABORATION — The recent discovery of the iron-based superconductors with unconventional superconductivity as a new class of superconductors has attracted great attention and triggered extensive research for new compounds. We report the new superconductor $Ca_{11}Bi_{10-x}$, which is in fact a Zintl phase. The structure of $Ca_{11}Bi_{10}$ contains three discrete anionic fragments: isolated Bi^{3-} ions, dumbbells of Bi_2^{4-} and square planar rings of Bi_4^{4-} surrounded by Ca^{2+}cations. The Bi_4^{4-} squares and the Bi_2^{4-} dumbbells interact with one another through Bi—Bi bonding to form an extended 3D framework. The extended three-dimensional Bi-Bi interactions are responsible for the metallic behavior observed above T_c. Electronic band structure calculations at the density functional theory (DFT) level confirm the metallic character of the material. Defects in the form of vacancies on the Bi-sites were also found using single crystal X-ray analysis. The unexpected finding is that unlike most superconductors $Ca_{11}Bi_{10-x}$ has very low carrier density. The $Ca_{11}Bi_{10-x}$ system is the first member of the intermetallic class $M_{11}X_{10}$ (M=Ca, Sr, Ba; X=Bi, Sb) that exhibits superconductivity suggesting that a broader family of Bi or Sb-containing superconductors may exist.

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