Preparation, Properties, and Crystal Structure of Quaternary Silicide Carbides \( R\text{Cr}_2\text{Si}_2\text{C} \) (\( R = \text{Y, La - Nd, Sm, Gd - Ho} \))

Marc W. Pohlkamp and Wolfgang Jeitschko
Anorganisch-Chemisches Institut, Universität Münster, Wilhelm-Klemm-Straße 8, D-48149 Münster, Germany
Reprint requests to W. Jeitschko. Fax: +49-(0)251 83-33136. E-mail: jeitsch@uni-muenster.de
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Quaternary Silicide Carbides

The title compounds were prepared by arc-melting cold-pressed pellets of the elemental components. They crystallize with a tetragonal structure already reported for CeCr\(_2\)Si\(_2\)C. It was refined from single-crystal X-ray data of PrCr\(_2\)Si\(_2\)C: \( P4/nmm \), \( a = 402.2(1) \text{ pm}, \ c = 535.2(1) \text{ pm}, \ Z = 1, R = 0.012 \) for 252 structure factors and 10 variable parameters. Magnetic susceptibility measurements with a SQUID magnetometer indicate Pauli paramagnetism for YCr\(_2\)Si\(_2\)C, while CeCr\(_2\)Si\(_2\)C shows mixed valent behavior. The carbon atoms in the structure of these compounds are isolated from each other. The silicon atoms form pairs with a Si-Si distance of 245.3 pm, somewhat greater than the single-bond distance of 235.2 pm in elemental silicon. Together with the chromium atoms, the silicon pairs and carbon atoms form a three-dimensionally infinite polyanion, which has some similarity with the polyanions found in several related tetragonal structures, e. g., the structures of ThCr\(_2\)Si\(_2\) and LuNi\(_2\)B\(_2\)C.