Results of Microscopic Evaluation of Coals used to Produce Silicon Metal and Ferroalloys

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Eight coals that are acknowledged as suitable for the manufacture of silicon and silicon-rich ferroalloys in the electric furnace were included in this study. These coals were characterized in terms of their proximate and sulfur analyses, petrographic maceral composition and vitrinite reflectance analyses.Chars/cokes were prepared from each of the coals and characterized for their microstructures. The chars were tested for reactivity to silicon monoxide at 1650° C. Chars partly reacted to SiO were studied using an SEM microprobe and an optical microscope to trace the gas diffusion paths of SiO gas and the formation of silicon carbide. In general the reactivity towards SiO gas increases as the coal rank or vitrinite reflectance decreases for bituminous coals. Coarse inertinite such as semifusinite and some fusinite increase the reactivity to SiO gas. Fine inerts, such as micrinite, tend to increase wall thickness and appears to decrease reactivity to SiO gas. The liptinite macerals appear to increase reactivity by increasing connected pore development in the chars. Future studies will be conducted to verify these findings and to define the upper and lower limit of coal rank for optimum production of silicon-rich alloys. Silicon carbide formation is topochemical and is controlled by SiO diffusion through pore structures. The overall performance of a coal in the production of silicon-rich alloys, is influenced by the fundamental properties of rank and composition of the coal. These data will be useful in the more efficient selection of suitable coals.