CHAPTER 22

CEMENTED CARBIDES AND CERMETS

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INTRODUCTION

The materials commonly known as cemented carbides or hard alloys are actually a wide variety of metal matrix composites in which one or more types of hard carbide (and sometimes carbonitride) particles are bound together by a ductile metallic binder. The history of cemented carbides is relatively short. After appearing in the 1920s, they were implemented in industry in the 1930s as carbide-to-steel brazed cutting tools, resulting in a jump in productivity and the quality of machining steels.

Although the cemented carbides are best known for their use in metal cutting tool bits, they are found in many applications that require one or more of the outstanding physical and mechanical properties of these materials—extremely high hardness, high compressive strength, rigidity and impact resistance, excellent wear and corrosion resistance. Typical applications include brazed metal cutting tools, wood cutting tools, abrasive wheels, metal-forming tools such as punches and dies, slitters and rolls, seal rings and valve sets in combustion engines, wear- and heat-resistant brazed parts in jet engines.

Several techniques for joining the cemented carbides to metals or ceramics have been developed. The major techniques are brazing and mechanical fastening. Brazing is a successful and reliable method of mounting carbides to steel shanks (see Figure 22.1) or other base materials. The specifics of brazing design and technology are generally influenced by (1) a large difference between cemented carbides and most faying structural alloys with respect to the coefficient of thermal expansion (CTE) and (2) a high content of the carbide phase in the structure of these materials. Special attention should be paid to (1) providing sufficient wetting of carbides by the molten brazing filler metal and (2) minimizing thermal strains in brazements. However, the strength of cemented carbide brazed joints is significantly better than that of ceramic joints due to presence of the metallic phase in the former’s structure.

BASE MATERIALS

Cemented carbides vary widely in compositions, but with respect to brazing, the following general classifications can be made: