Poco Graphite, Inc.

ZEE Performance under Production Conditions

White Paper
March 2004

Test designed to validate field reports on ZEE performance

Section 1: Introduction

As a manufacturer of specialty materials, POCO is in a unique position to use its materials research and development teams, pilot plant production, laboratories for material analysis characterization, and long relationships with OEMs and end users to develop targeted materials for specific applications. The development of a new material targeted for high wear and high energy implant components was based on past performance data for graphites in this application. It was assumed that a graphite material with the right combination of grain size, hardness and uniform microstructure would yield fewer particulates on the wafers and would exhibit reduced erosion in current and next generation processes.

The development process determined that this new graphite grade would need a grain size of 1 micron (smallest that is currently manufactured), a shore hardness above 100, purity levels below 2 ppm and a uniform microstructure. This graphite material developed specifically for high-wear, consumable implant components was trade named ZEE.

When ZEE was released to several beta customers the initial reports from the fabs validated POCO's premise. Although the field information was semi-qualitative, reports suggested that component life increased from 1.5 to 4 times depending on the part, equipment and process involved. In order to better understand the performance of ZEE, a series of tests were undertaken in a production environment.

Leading materials tested under production conditions

Section 2: Test Parameters

Materials—The MRS vane from 3 materials were chosen—POCO's ZEE and SCF along with a commercially available VI parts. The test was designed to compare these three materials under production implant conditions and evaluate the performance differences between these materials. Of particular interest was to explore the combination of microstructure, hardness and particle size that lead to reduced erosion and reduced particulates.

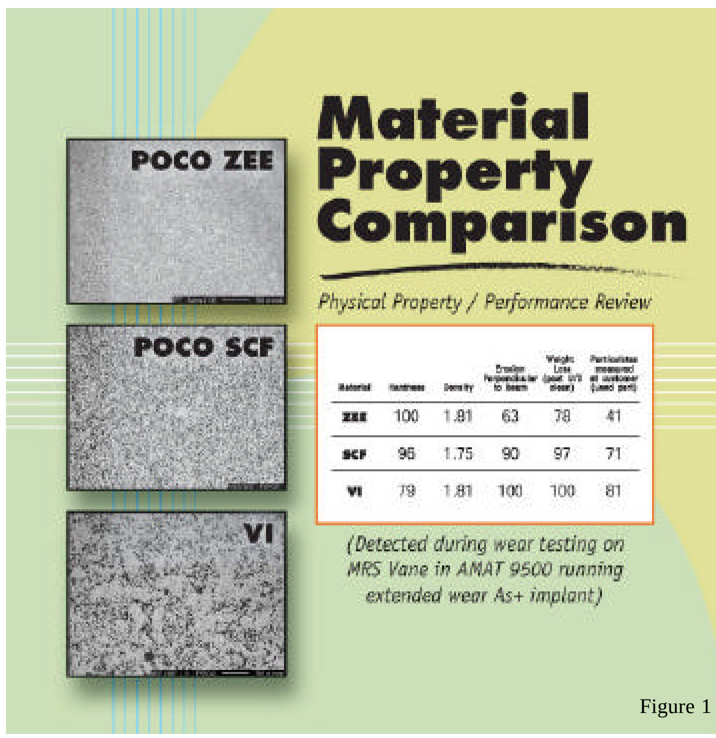

Figure 1

Materials differences included grain size from 1-10 microns, the uniformity of material depending on manufacturer and the Shore hardness from 79-106. (See Figure 1)

Equipment—Applied 9500XR located in a CPU fab in central Texas.

Process—Arsenic implant with dose of 80 keV and energy level of 15 mA. The process simulated extended lifetime conditions. The MRS Vanes were run slightly pinched down to simulate extended wear. Results were measured to identify erosion resistance and the amount of particulates added to monitor wafer during the test period. The process was run continuously for 20 hours. The test compared particles coming off the graphite after 20 hours in the chamber onto the wafer. Each test wafer saw one process run.

Particle levels were tested before and after each process. The MSR vanes were weighed before and after the run. The parts were dimensionally measured to capture the erosion of each part.

Component—MSR vane was chosen due to environmental constraints of the system. This part could easily be removed without affecting the rest of the beam line. There were two, identical test components from each material.

Duration—Each process run was 20 hours. Each test wafer saw one process run near the end of the 20 hours.

Test measured particulates generated and resistance to erosion

Section 3: Measurements Performed

Measurements taken on each vane were averaged for each test and compared to the other runs. Final data is normalized for comparison purposes.

The data was measured as follows:

Dimensional—5 sites measured along erosion surface.

Weight—Parts weighed after ultrasonic clean at end of run.

Particulates—After vanes installed, a particle check process run was used to verify that the system was running optimally. After the extended run, the particle check process was repeated to simulate particle performance on a wafer based on the erosion of component over its lifetime. The particle monitor wafers were measured using a Tencor 6200 capable of measuring down to 0.16 micron.

ZEE has lowest erosion rate of materials tested

Section 4: Results

Based on dimensional measurements, components made from POCO ZEE showed lower wear than either POCO SCF or VI. (See Figure 2)

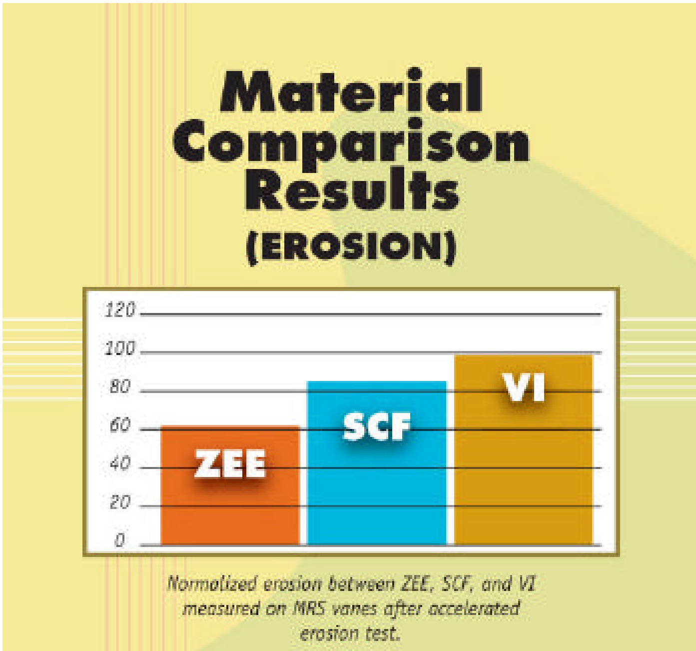

Figure 2

ZEE generated fewer particulates than competitive materials

Components manufactured from ZEE showed less weight loss than SCF or VI components. (See Figure 3)

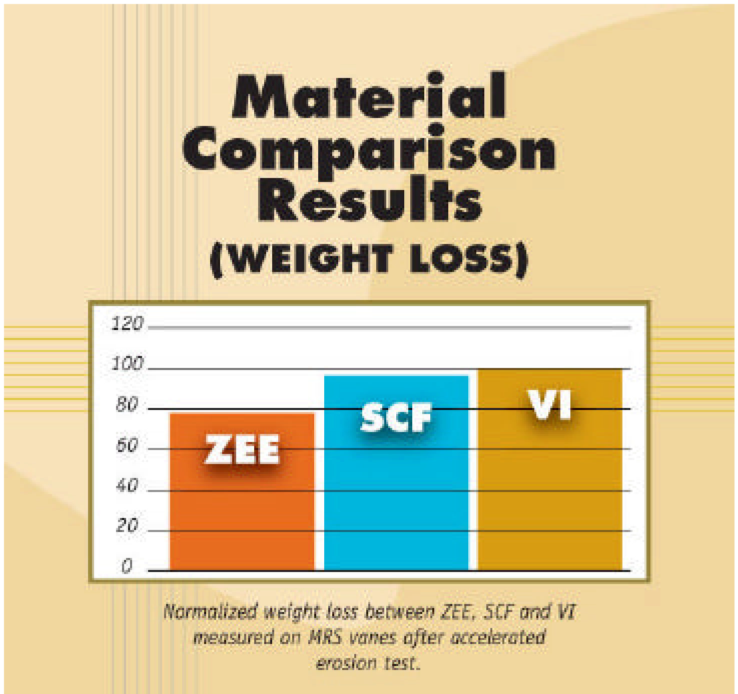

Figure 3

Fewer particulates were measured on the monitor wafer from the runs using ZEE MRS vane. (See Figure 4)

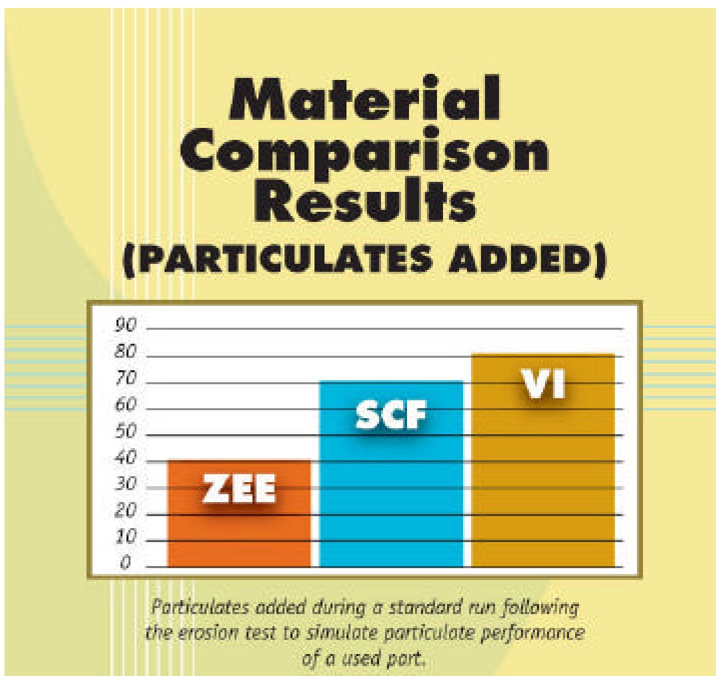

Figure 4

ZEE outperforms VI

Section 5: Conclusions

The physical properties that impact erosion resistance are particle size and hardness. While VI and ZEE had the same density, the overall performance was at opposite ends of the scale. The particles generated during the process run using ZEE were half of that generated by the VI components. The erosion resistance of ZEE was 40% less than VI.

The performance results between SCF with a 5 micron particle size and VI with a 10 micron grain size was somewhat similar. Only ZEE exhibited significant performance differences from the other two materials.

It is possible that performance is an interaction of several physical property variables. The data shows that significant performance can be achieved from a combination of physical properties that include 1 micron grain size, Shore hardness above 100 with a uniform microstructure.

This test did not address improved yield results, but it is interesting to note that the fab that ran the test has switched all graphite materials from OEM standard materials to POCO ZEE and has experienced a reduced cost per wafer in the fab.

About Poco Graphite, Inc.

Poco Graphite, Inc. has been a provider of superior materials solutions for 40 years. POCO manufactures a full line of specialty graphite and silicon carbide materials that are routinely used in a wide range of highly technical and industrial applications. These materials have earned the reputation of being the best in the industry. POCO's materials and products are marketed world wide for applications in semiconductor, biomedical, optical/electronics, aerospace, general industrial, and EDM (electrical discharge machining).

POCO is a privately held company with corporate headquarters and manufacturing facilities located in Decatur, Texas USA. Regional headquarters are located in France and China. Applications specialists are located throughout Europe and Asia.

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