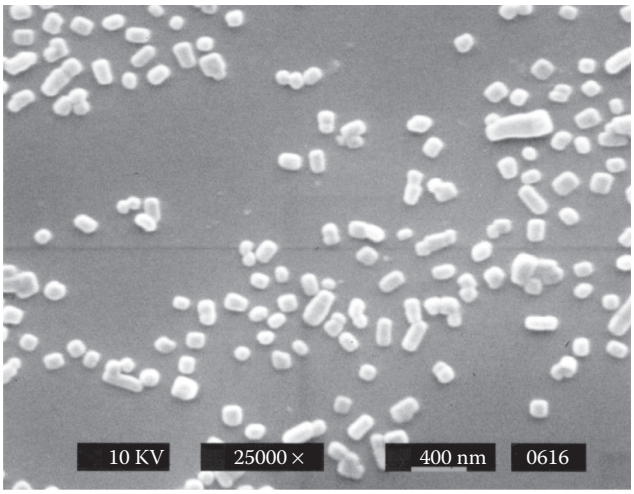

FIGURE 17.5 Scanning electron micrograph of steroid crystals comminuted in a wet ball mill to submicron dimensions. (Data generated by NanoSystems, Elan Drug Technologies, a member of the Elan Corporation, plc.)

The chamber is charged with grinding media to approximately 80% of its volume. The grinding media is typically glass, ceramic, zirconium or plastic of spherical shape with diameter of approximately 0.2–4 mm. The shaft is made to rotate at a high velocity, approximately 20,000 rpm, and the suspension of material is pumped through the grinding chamber to effect size reduction of the suspended material.

Particle comminution occurs owing to a compression–shear action produced by the rotating disks and grinding media.

The liquid medium used for suspending the particles can serve special purposes—such as lubrication and coating of newly formed particles through various physicochemical interactions (electrostatic, hydrophobic, etc.) (Verhoff et al., 2003; Moschwitzer and Muller, 2006).

Microfluidization

Microfluidization is a process involving a high-pressure fluids processor that delivers unique product capabilities, including particle size reduction to nanosized particles for dispersions, emulsions, and liposomes. Microfluidizer processors overcome limitations of conventional processing technologies by utilizing high-pressure streams that collide at ultrahigh velocities in precisely defined microchannels. Combined forces of shear and impact act upon products to create finer, more uniform dispersions and emulsions than can be produced by any other means.

Particle size reduction of a material suspended in a liquid medium can be affected by a Microfluidizer® processor (Microfluidics Corp., Newton, MA, http://www.microfluidicscorp.com/processors.html). A schematic of a Microfluidizer processor is presented in Figure 17.6. In a Microfluidizer processor, a liquid stream is bifurcated and the two streams are directed upon each other under pressures as high as 40,000 psi. Particles suspended in the liquid are reduced in size by forces of shear and cavitation. Suspensions can be prepared with the Microfluidizer processor with mean particle sizes in the micron to submicron range.

The Microfluidizer high shear processor technology is widely used in the pharmaceutical, biotechnology, digital ink, microelectronics, food, chemical, and personal care industries.