smaller coarse particles must be removed as the dielec-

product grade. JEF Mineral manufactures the main product grades (NFP201, NFP301, and NFP401) by the CVD process in which vaporized nickel chloride is reduced by hydrogen. The average particle size and the particle size distribution of products are controlled mainly by adjusting the operating conditions of CVD reactions. Nevertheless, since coarse particles of 1 μm or larger still exist at ppm order in number, it is difficult to further decrease the quantity of coarse particles by CVD reaction control alone. MLCC has grades of layering several hundred dielectric layers and electrode layers, thus the rejection rate of MLCC products is seriously affected by the existence of coarse particles of even ppm order. With this background, JFE Mineral has established a process flow to remove coarse particles from the nickel ultrafine powder manufactured by the CVD process by applying classification after refinement. Grades of NFP201S, NFP301S, and NFP401S are manufactured by classifying the conventional product grades of NFP201, NFP301, and NFP401, respectively, by wet-centrifugal separation, thereby removing coarse particles of 3 μm or larger.

Furthermore, JFE Mineral has developed a more precise classification process, and has successfully removed coarse particles of 0.8 μm or larger. This new product grade is NFP201X.

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Melql . shows SEM images of NFP201S, NFP301S, NFP401S, and the new product grade NFP201X in which coarse particles are removed. As seen in Photo 1, reduction in the average particle size makes the particle size distribution sharper. **Cfdrob 1** compares the number of coarse particles measured by SEM. For NFP201S, NFP301S, and NFP401S, the counted number of coarse particles of 3 µm or larger is zero, and the number of coarse particles of 1 µm or larger is also decreased compared with standard particles. For NFP201X, the number of coarse particles of 0.8 μm or larger is significantly decreased.

Q^_ib . shows the powder characteristics of each classified product grade. The BET specific surface area is stabilized by minimizing the thickness of the surface oxide layer and by decreasing the irregularity of the particle surface.

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NFP201S, NFP301S, and NFP401S, in which coarse particles of 3 μm or larger are eliminated by classification after CVD process, are popular in the market as nickel ultrafine powder for the internal electrodes of MLCC. In particular, NFP201S contains less coarse particles of 1 μm or larger, causing demand for this grade to increase rapidly as the electrode material for mass-produced