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Low-Voltage Electron Microscopy for Nanoparticle Characterization

The LVEM 5 is a cost-effective, reliable tool for nanoparticle characterization, offering a strong alternative to traditional high-voltage TEM.

As the nanomaterial industry continues to expand, there is an increasing demand for accessible tools that can handle routine nanoparticle characterization without the burden of high costs and maintenance. Low-voltage electron microscopy (LVEM) fills this gap by offering a solution that delivers strong performance offering advantages such as reduced cost and maintenance, simpler operation, reduced beam damage, and compact design. A study by Dazon et al. (2019) compared the performance of a low-voltage TEM, the LVEM 5 operated at 5 kV, against a conventional high-voltage TEM, a Philips CM200, operating at 200 kV. They characterized two nanoparticle samples, TiO_2 and SiO_2, as well as two reference colloids, ERM FD 304 and NM 300 K. The study aimed to assess how effectively a low-voltage TEM could measure the number size distribution of nearly spherical constituent particles, a key parameter in nanoparticle research.

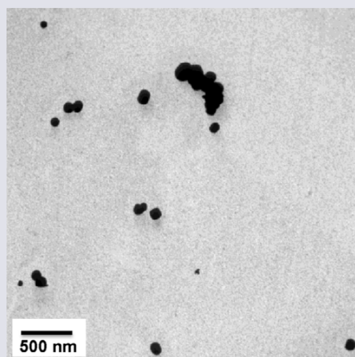

Fig A. *TiO_2*
Dropcast on carbon film.
(LVEM 5, TEM)

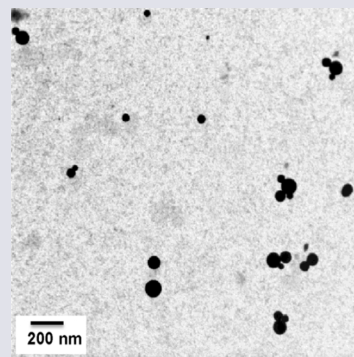

Fig B. *SiO_2*
Dropcast on carbon film.
(LVEM 5, TEM)

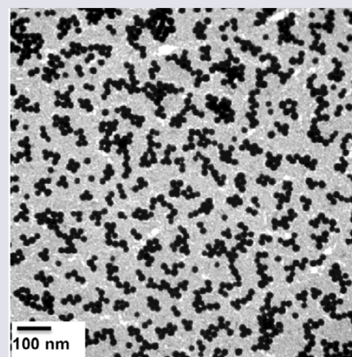

Fig C. *ERM ED 304*
Dropcast on carbon film.
(LVEM 5, TEM)

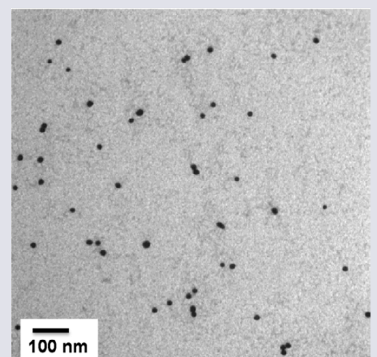

Fig D. *NM 300 K*
Dropcast on carbon film.
(LVEM 5, TEM)

While traditional TEM has long been the standard for high-resolution imaging, the cost, complexity, and maintenance requirements often limit its widespread use. Dazon et al. (2019) found that LVEM 5 shows sufficient resolution and a higher contrast compared to high-voltage TEMs for the material tested. For TiO_2, the deviation in measured particle sizes between the two systems was as low as ±2.5%. These results show that the LVEM 5 provides size distribution accuracy comparable to that of the high-voltage TEM for these nanomaterials.

The study also highlighted the LVEM 5's operational advantages. One of its key benefits is its compact size, which allows it to be installed in laboratories where space is limited and where maintaining a conventional TEM would be impractical. Furthermore, its simplified controls and reduced maintenance needs make it easier to operate, meaning that even users with minimal training can quickly become proficient. Sample exchanges on the LVEM 5 takes just a few moments, in contrast to the more time-consuming process required for traditional TEM. This significantly increases throughput, making the LVEM 5 an ideal choice for laboratories that require frequent nanoparticle analysis. For more complex tasks, Delong Instruments also offers the LVEM 25E, which provides higher resolution and more advanced capabilities to meet a broader range of research needs.

Conclusion

LVEM provides a reliable and cost-effective alternative to high-voltage TEM for nanoparticle characterization. Its accessibility, ease of use, and ability to deliver clear, high-contrast images of nanomaterials make it a valuable tool for both industrial and research applications. The comparison conducted by Dazon et al. (2019) suggests that LVEM could be used by risk prevention professionals in routine checks to identify nanomaterials more easily than with conventional TEM. For laboratories seeking a more accessible solution for nanoparticle analysis, the LVEM 5 is a reliable choice that doesn't compromise on performance.

References

Dazon, C., Maxit, B., & Witschger, O. (2019). Comparison between a low-voltage benchtop electron microscope and conventional TEM for number size distribution of nearly spherical shape constituent particles of nanomaterial powders and colloids. Micron, 116, 124–129.