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GROUP REF. : D1
PREF. SUBJECT : 2: Materials for Electrotechnical Purposes
QUESTION N° : 2.09

Question 2.09:
Is the reduction in the number of contributions on nanocomposites a sign of waning interest, acceptance that bulk processing remains a significant challenge or a reflection that these materials are moving towards real-world deployment? How close is the industry to deployment of nanocomposites?

Answer :

- In a part of our project, nanocomposites are being developed for the new insulating materials of stator coils of large-size rotating machines on the premise of commercialization, as described in Figure 1.
- Loss reduction and the higher efficiency of the rotating machines can be achieved by improving the dielectric strength, reducing the thickness of the ground-wall insulation, and expanding the cross-section of coil conductors.

- Nanocomposite material design guidelines for the desired insulation performances, i.e., the appropriate nanofiller dispersion state, the allowable agglomerate size, the desired type of filler material, and the optimized filler volume fraction, were established by a series of academic research.
- Figure 2 summarizes experimental results of the AC breakdown strength and the insulation lifetime, as functions of the maximum agglomerate size and the volume fraction of TiO2 nanoparticles. (Larger circle represents the superior insulating properties.)

- Real-scale stator coil models were manufactured, in which conductors were wound by mica tape and vacuum impregnated with nanoparticle-filled epoxy resins, as shown in Figure 3. The insulation lifetime characteristic, which is the most essential factor for the high voltage stator coil insulation, was successfully demonstrated by the long-term voltage-endurance test during this 5-year-project (Figure 4).
- At present, other properties, such as thermal and mechanical degradation properties, are being investigated. The nanocomposite material is technically feasible for practical use if these are cleared.

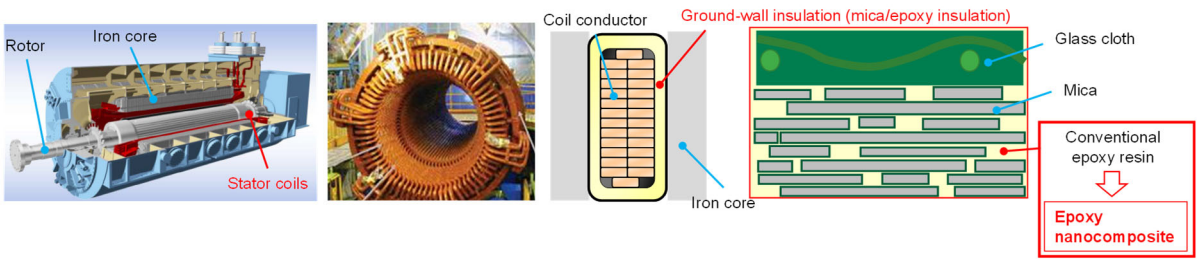

Figure 1: Insulation structure of the stator coil of the large-size rotating machine.

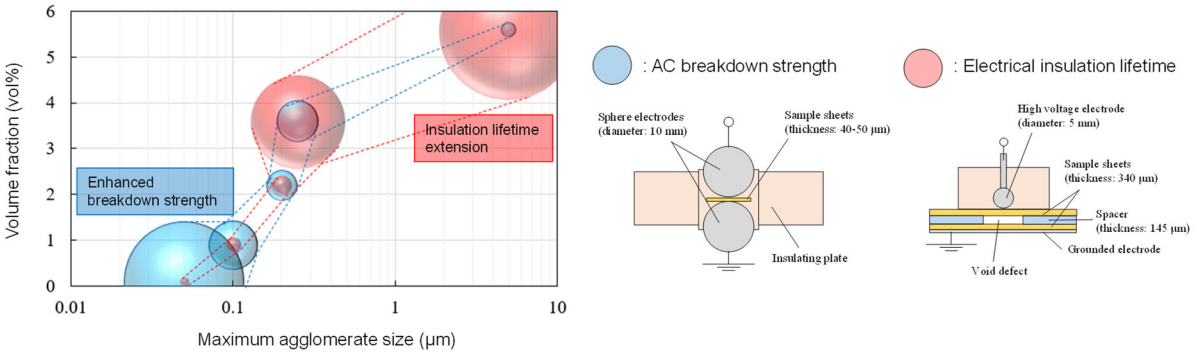

Figure 2: Breakdown strength enhancement and lifetime extension effect as functions of the maximum agglomerate size and volume fractions.

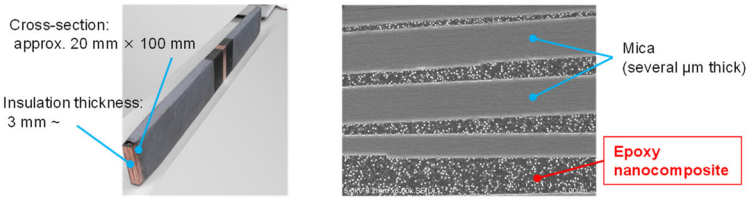

Figure 3: Real-scale stator coil model and its SEM image.

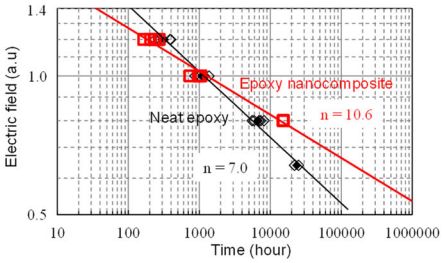

Figure 4: Voltage-endurance test.