

Recent Progress of HTS SQUID Application in Japan

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Abstract - Since the first demonstration of quantum interference between two Josephson junctions connected in parallel in a superconducting loop 50 years ago, the technology of superconducting quantum interference devices (SQUIDs) has much advanced. Nb-based LTS SQUIDs using Nb/AlOx/Nb junctions are currently used as the most sensitive magnetic sensors or amplifiers in many fields. On the other hand, HTS SQUIDs using RE123 cuprate superconductors have attracted much attention, mostly because of easy cooling with liquid nitrogen, though their field noise is substantially higher compared with LTS SQUIDs operating at 4.2 K. In Japan, many compact systems for magnetocardiography, metallic contaminant detection, magnetic immunoassay, non-destructive evaluation, and mineral exploration were previously developed utilizing single-layer HTS SQUIDs based on grain-boundary junctions, and only a few systems were actually used. Since the development of multilayer HTS SQUIDs based on ramp-edge junctions at SRL-ISTEC, they have been applied to several systems with the aim of realizing practical systems with high performance. For instance, a compact electromagnetic exploration system for metal resources (SQUITEM3) with a high slew rate has been developed on commission by JOGMEC, and is now used in actual exploration. This has been followed by other JOGMEC projects to develop a magnetic survey system for metal resources and an electromagnetic logging system for monitoring an oil reservoir. Bio-sensing systems have also been developed under the support by JST.

Keywords – SQUID, HTS, multilayer, ramp edge junction, magnetocardiography, contaminant detection, immunoassay, NDE, mineral exploration