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New inspection method of joint resistance at room temperature for ITER TF Coil

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It is important to achieve sufficiently low joint resistance (RJ), such as order of nano ohm, in ITER TF coils. However, a huge equipment is necessary to measure RJ at 4 K because of huge mass and size of TF coil. On the other hand, according to experiences by the authors, good RJ could be successfully achieved in ITER EDA model coils. In addition, severe process control is being done in ITER TF coil joint manufacture. However, it is useful to confirm RJ with simpler inspection. Authors therefore developed the inspection method, which enables to detect some abnormality in joint, while it is not direct estimation of RJ at room temperature. RJ of TF coil joint is mainly determined by contact resistance between cable and copper sole of the joint box (R_c), and contact resistance between copper sole soldering. Quality of soldering can relatively easily be controlled by process control and inspected by visual inspection. In contrast, R_c cannot be inspected at all so far. Therefore, the authors focused on development of inspection of R_c . R_c affects current penetration length (CPL) between cable and copper sole. The author thus supposed that when joint could be fabricated with proper process (i.e. R_c is sufficiently low), the behavior of CPL is repeatable. On the other hand, when there is some abnormality in manufactured joint, we can find irregular behavior on CPL from the normal repeatable behavior. Thus, authors established measurement system to acquire voltage profile of copper sole at room temperature. As results of the measurement, good repeatability of CPL could be shown in actual all ITER TF coil joints tested, while significant difference of CPL was observed in a joint sample which includes some disturbances. Thus, we can conclude that simple inspection method of R_c could be developed.

Submitters Country

Japan

Primary author: Dr KAJITANI, Hideki (National Institutes for Quantum and Radiological Science and Technology)

Co-authors: Dr HEMMI, Tsutomu (National Institutes for Quantum and Radiological Science and Technology); Mr UNO, Yasuhiro (National Institutes for Quantum and Radiological Science and Technology); Mr SHIMIZU, Tatsuya (National Institutes for Quantum and Radiological Science and Technology); Mr YAMANE, Minoru (National Institutes for Quantum and Radiological Science and Technology); Ms NAKAMOTO, Mio (National Institutes for Quantum and Radiological Science and Technology); Dr MATSUI, Kunihiro (National Institutes for Quantum and Radiological Science and Technology); Dr KOIZUMI, Norikiyo (National Institutes for Quantum and Radiological Science and Technology)

Presenter: Dr KAJITANI, Hideki (National Institutes for Quantum and Radiological Science and Technology)

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