

特別講義

明治大学 国際交流基金事業

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Hard and Soft Ferrites - Still Searching for Better Magnetic Ceramics?

2025年6月19日 木 2限 10:50~12:30

明治大学 生田キャンパス

第2校舎A館 A402教室

講演詳細（使用言語は英語です）

Hard and soft ferrites represent a mature family of ceramic magnetic materials with large commercial impact. Research and commercial usage of ferrites started in Japan in the 1930-ties. From then on, ferrites have become a pivotal field of materials research. Hexagonal M-type ferrites started their triumphal march as good and inexpensive permanent magnets in the 1950-ties. Significant progress was made later on by LaCo and CaLaCo co-substitutions, which led to a substantial increase in performance. Until now, research on W-type hexagonal ferrites as substitute permanent magnets continues. However, synthesis conditions are complex and require sintering in low oxygen partial pressure of oxygen p_{O_2} . Spinel-type ferrites, on the other hand, play an important role in electronics as soft magnets in coils and transformers. Low-loss Mn-Zn power ferrites were developed for operating frequencies up to 3MHz. These ferrites are sintered and cooled in controlled atmosphere with defined T- p_{O_2} protocols to tailor the defect chemistry and the magnetic properties. Low-temperature fireable Ni-Cu-Zn ferrites are used in multilayer inductors. The ferrite chemistry and powder morphology is optimized for multilayer technology. Spinels, garnets or hexagonal ferrites play a major role in microwave applications, e.g., in circulators for satellite communication systems. Some new research directions have emerged in the last years. Hard – soft ferrite composites are studied as future permanent magnets. Soft ferrite layers are integrated as inductive components in complex LTCC multilayer modules. This paper summarizes recent developments and the actual status of ferrite materials.

講師紹介 Jörg Töpfer 博士

He is a professor of Inorganic chemistry, glass and ceramics at the Ernst-Abbe-Hochschule Jena, Germany. His research includes fundamental aspects and engineering problems of functional ceramics and oxide materials. He is a member of the board of the German Ceramic Society and of the editorial board of the Journal of the European Ceramic Society.



主催：明治大学 理工学部専任准教授／小原学

共催：明治大学 国際連携本部

問い合わせ先： obara@meiji.ac.jp（小原学）