Project No. 02512

Report form of Joint Research Project at ZAIKEN (FY2025)

Title of Project	**Fabrication of composite materials based on semiconducting oxides and precious metal for multifunctional applications**		
Priority Area	**III-B Energy Saving & Structures** **III-C Energy Saving & Properties**		
New proposal or **Continuation**			
Name of Main Applicant	HOANG Nam Nhat		
Institution	Vietnam National University, University of Engineering and Technology	**title**	Professor
Name of partner applicants (if any)	Nguyen Quang Hoa		
Name of the host faculty at Waseda	Prof. YAMAMOTO Tomoyuki		

Aim of the research project

In this study, we aim to research, develop, and manufacture new composite materials with enhanced absorption capabilities in the visible light region, to facilitate efficient hydrogen production through water splitting and can be used as SERS sensors to detect toxic substances in the environment.

(1) Materials preparation:

- The new materials are prepared by rapid quenching method by a rapid quenching system installed in the Vietnam National University.

(2) Materials characterization:

- The characterizations are carried out at Waseda university, Tokyo, Japan, in particular, the structural and magnetic characterization by mean of X-ray diffraction and Superconducting Quantum Interference Device (SQUID) measurements.

The expected outcomes include (Automotive & Energy saving):
- Properties of materials under the studied factors will be applied to advanced management techniques of energy consumption and energy saving.

Contents and results of the research
(Please indicate to which extent the expected objectives in your proposal have been achieved.)

According to the research plan specified in this research proposal, we have carried out the following materials preparation and characterization:

(1) The ribbons of Co-based alloys were prepared by rapid quenching method (at VNU).

(2) The structural characterization (X-ray diffraction measurements and the magnetic characterization (VSM and SQUID) (at Waseda Univ.).

The typical results are shown in two figures below. Fig.1 shows the hysteresis loop of the Co-based ribbon. Fig. 2 shows the magnetic flux density and permeability dependent of magnetic field curves the Co-based ribbon.

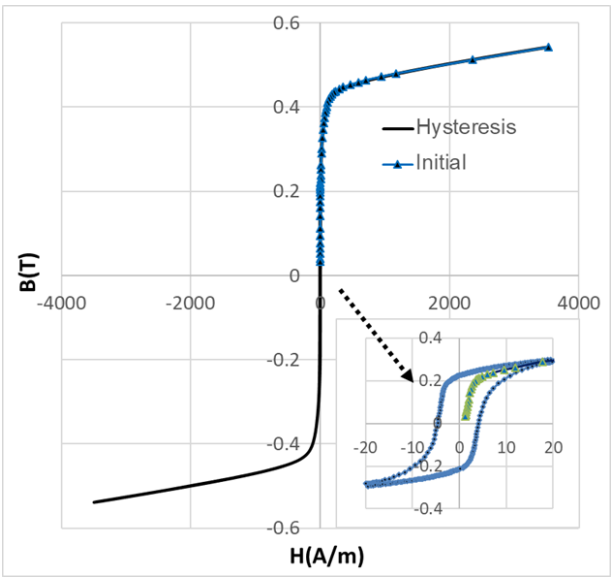

Fig.1. Hysterisis loop of the Co-based ribbon.

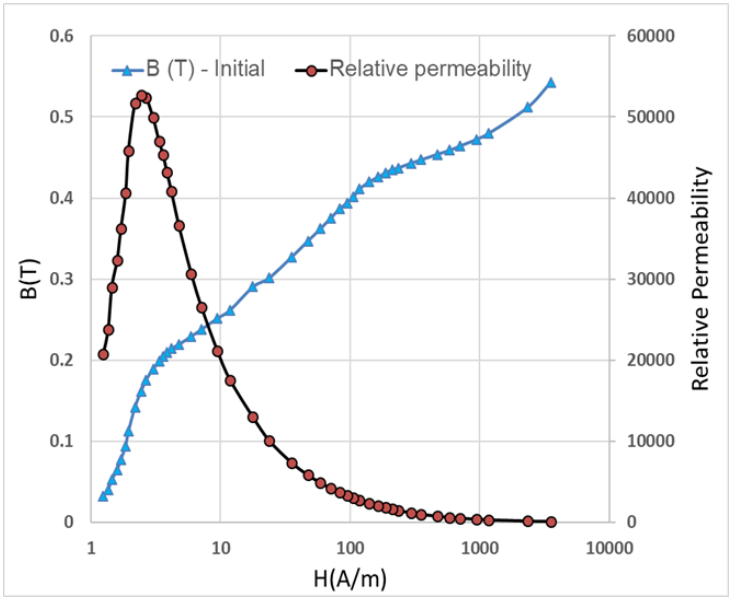

Fig.2. The magnetic flux density and permeability dependent of magnetic field curves the Co-based ribbon.

The broad peaks near $2\theta \approx 45^{o}$ in the X-ray diffraction pattern are evidence of the amorphous structure of the as-cast Co-based ribbon. The Co-based ribbon achieved excellent soft magnetic properties with saturation induction B_S = 0.55 T, coercivity H_C = 4 A/m, and maximum permeability μ_{max} = 55000, which is related to the complete crystallization of the α-CoFe(Si) phase in the sample. The Co-based ribbon have potential for use as highly sensitive magnetic sensors as well as other soft magnetic material applications.

Outputs of the project (publications, presentations, patents)

We are currently summarizing the measured data and plan to present them at the coming international conferences, e.g., 9th International Symposium on Frontiers in Materials Science to be held in November 2026 and then publish them in one of the high-impact international journals in the field of materials science.