



Title of Project : Electromagnetic Metamaterials

Term of Project : FY2010-2014

Masanori Hangyo
(Osaka University, Institute of Laser Engineering, Professor)

【Purpose of the Research Project】

Electromagnetic metamaterials are artificially structured materials having effective permittivities and permeabilities which cannot be obtained by natural materials. Metamaterials are made by arranging elements (meta atoms) much smaller than wavelengths. For example, both the permittivity and permeability become negative by the proper design and arrangement of meta atoms, resulting in the anomalous properties such as negative refraction and perfect lens. In this project, we consider metamaterials as novel electromagnetic and/or optical functional materials. We will establish a new metamaterial field by combining effectively the creation of new concepts, developments of design and fabrication methods, and demonstration of novel physical phenomena.

【Content of the Research Project】

The methods of fabrication and their difficulty are different between electromagnetic (microwave and THz) and optical (near-infrared and visible) regions. On the other hand, there are two methods in designing metamaterials: 1. periodic structures operating by tightly combining meta atoms with each other and 2. resonant structures utilizing the resonance of individual meta atoms. Considering the above situation, the present project is made of six planning research groups as shown in Fig. 1.

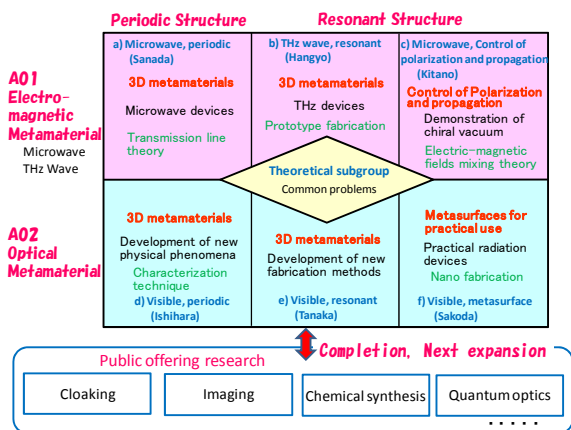


Figure 1 Organization of the research groups.

The A01 team (groups a, b, and c) and the A02 team (groups d, e, and f) carry out the research in the microwave & THz and optical regions, respectively. The theoretical sub-group is organized to solve common theoretical problems. The main research targets are 1. design and fabrication of 3D metamaterials, 2. prediction and demonstration of novel phenomena, and 3. creation of novel devices.

Public offering researches include the important subjects not covered by the planning research groups and those leads to the future expansion.

【Expected Research Achievements】

By this project, the design and fabrication methods of 3D metamaterials will be established, and the unique phenomena expected for metamaterials such as reversed Cherenkov radiation and negative radiation pressure will be proved experimentally. The chiral vacuum, which is predicted for chiral metamaterials, will be also proved experimentally. Further, novel devices using metamaterials will be realized. These expected achievements are shown in Fig. 2

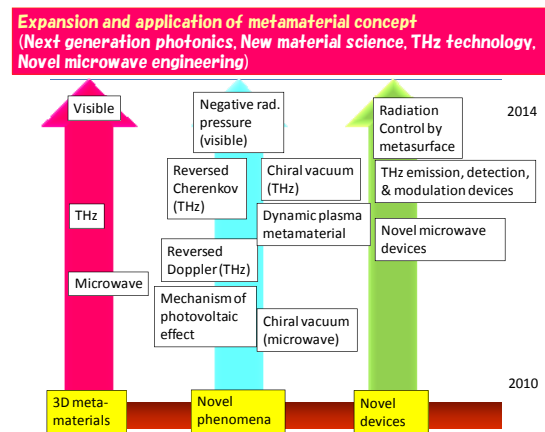


Figure 2 Expected achievements.

【Key Words】

metamaterial, left-handed medium, negative refraction, chiral medium, reversed Cherenkov radiation, photovoltaic effect, device

【Homepage Address】

<http://www.metamaterials.jp/shingakujuets>