Exploring Novel Electromagnetic Circuit Based on Management of Low-Dimensional Plasmonic Dispersion

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【Outline of survey】

This research explores novel electromagnetic circuit based on management of low-dimensional plasmonic dispersion in the millimeter-wave to terahertz-wave domain for the purpose of realization of integrated circuits/systems which enables overly broadband signal-processing functions, such as an oscillation, amplification, frequency conversion, and logic processing. Study is essentially focused on the following four primarily important circuit functions: "unique transmission", "amplification", "frequency conversion", and "temporal logic". On the basis of such a unique approach, new functional elements operating in the terahertz domain at room temperature will be developed with a semiconductor heterojunction material systems and nano-metamaterial process technology. Furthermore, establishment of the millimeter-wave and terahertz-wave circuit theory based on the new concept of "weaving a circuit function into material and structure" is aimed at through creation of these new conceptual devices and circuits. The research is extensively promoted by the cooperation with Professor RYZHII Victor (University of Aizu), Professor Eiichi Sano (Hokkaido University), and Assistant professor Koichi Narahara (Yamagata University). Collaboration with Professor DYAKONOV Michel (the Montpellier University in France) and Professor SHUR Michael (Rensselaer Polytechnic Institute in US), who have pioneering achievements in plasma devices, is also advanced.

【Expected results】

If this research is successful, the “unexplored” terahertz band will be explored. A terahertz light source will be dramatically scaled down into microchip size from laptop size, and moreover, inside a chip, it becomes possible to manage complicated signal processing like DSP. Such a technological advancement will have tremendous power to the extent that information communication technology and industry are renewed. Consequently, Japan will secure the international initiative in the field concerned. Academic importance of creation of a new circuit theory will also be accomplished simultaneously.

【References by the principal researcher】

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- K. Narahara and T. Otsuji, "A traveling-wave time-division demultiplexer," Jpn. J. Appl. Phys., Vol. 38, Part I, No. 7A, pp. 4021-4026, 1999.

【Term of project】 FY2006－2010 | **【Budget allocation】29,100,000 yen**

【Homepage address】 http://www.otsuji.riec.tohoku.ac.jp