ELECTRICAL TAMM SOURCES

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IN COOPERATION WITH : Institut Lumière Matière

LEVEL : M2
TEAM(S) : MNP

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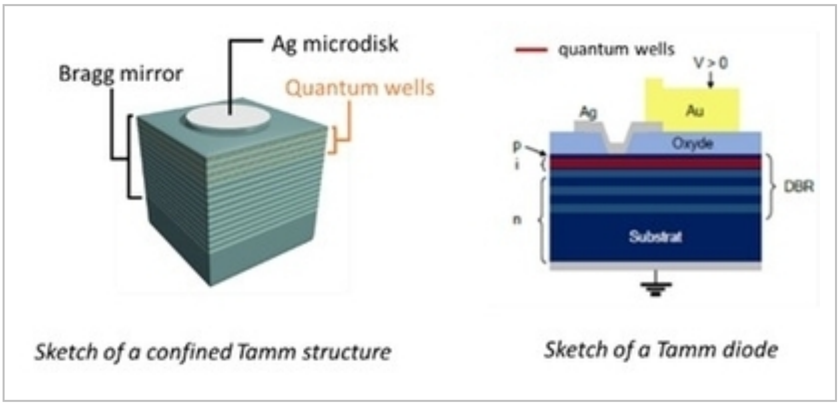
SCIENTIFIC CONTEXT :

The creation of original light sources is a renewed challenge due to recent needs in sub-wavelength microscopy and quantum optics. Recently our team demonstrated a new type of surface mode source based on Tamm plasmons. These are hybrid metal/semiconductor nanostructures, where the source is a GaAs quantum well.



Sketch of a confined Tamm structure

Sketch of a Tamm diode

The advantages of this type of source are twofold: firstly, it is possible to modify the emission properties very simply by nanostructuring the metal, and secondly, the metal patch confines the mode and is used for electrical injection. This latter property, associated with the surface character of Tamm plasmons, makes it possible to envisage large-scale addressable laser networks by separating the electrical injection part from the light emission part. Such addressable laser arrays are not possible with current technologies for reasons intrinsic to vertical cavity lasers.

The development of Tamm lasers, in particular large-scale electrically addressable sources, is finding applications in microscopy and microfluidics (lab on chip). The main advantage is that a coherent, directional beam of light can be delivered to any point on the sample only by electrical control of the addressable network, electrical control could thus replace lenses for the microscope or mechanics for optical tweezers.

The MNP team is a pioneer in the development of Tamm sources and has the optical, electro-optical and manufacturing means necessary for the development and study of these structures.

MISSIONS :

This internship, mainly experimental, focuses on the development of emitting devices based on semiconductor quantum wells coupled to Tamm plasmons. The objective of the internship is to demonstrate the laser effect in electrically excited Tamm structures and study first laser arrays (with a few devices). To do this, the person recruited will participate in the manufacturing of these devices and then characterize the electrically excited Tamm structures using electro-optical experiments at low temperature and at room temperature. The measurements can be coupled with simulations to analyze the results more precisely.

OUTLOOKS :

This work can lead to a PhD, where applications of electrical Tamm laser arrays will be developed.

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