STUDY ON A MODEL OF BRAGG DIFFRACTION USING MICROWAVES*

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In this paper we present the experimental set up to study Bragg diffraction on Microwaves. The diffraction of the waves was studied using a simple cubic lattice consisting of an array of steel balls. To generate microwaves, we used a reflex klystron coupled with a horn antenna. The detection of the diffracted wave was made using a detector coupled with a guide and a receiving antenna, the cubic lattice is disposed on the goniometric system. The wavelength of the microwaves can be determined using the method of Standing Wave. The paper can be used as a laboratory paper.

Key words: diffraction, Bragg, microwaves.

INTRODUCTION

Through diffraction is apprehended any phenomena produced by waves, when these meet on their path heterogeneities of the environment. The diffraction phenomena which appears in the case in which a source of light is far away, so that luminous ray by path are practice parallel, appointed the diffraction Fraunhoffer (in parallel light or plan waves).

The presence of an obstacle in microwaves field produces a disturbance in the propagation of waves: a part from the energy from the incident waves is reflected by the surface of the obstacle, while another part is transported farther through a phenomenon of rounds the obstacles by the wave.

A crystal is behaved as a 3 D diffraction network. To produce diffraction is necessary that the wave length of that radiation to be comparable with the constant of the network diffraction, the same measure order as the interatomic distance.

For Bragg diffraction study we used a cubical structure made by metallic spheres with a 1 cm diameter at a distance equally one from each other as the structure of NaCl presented in Fig. 1. The reflexion had maximal values if Bragg's Law is satisfied:

$n\lambda = 2d\sin\theta$, where n is the maximum order ($n = 1, 2, 3, \ldots$).

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Inside crystals, atoms and molecules are making networks with spatial structure, with a characteristic symmetry for that crystal. The network can be getting in the simplest way using lengthways at equally distances d_1, every atom. On can get in this way a linear network. Using a parallel linear row at the distance d_2 between them, so that all of them to be situated in the same plan, we get a planar network. The system of planar networks, get on distance d_3 between them will form a spatial network.

Bragg's Law is:

$$n\lambda = 2d\sin\theta,$$

in which d is the distance between atoms
n is the number of lengthways
λ is the wavelength of the incident radiation
θ is the incidence angle.

Bragg's Law was used first time to explain the X Ray interference through crystals and later to study the structures of different materials, so long as the used wavelength is comparable with the interatomic or intermolecular space of the investigated material.

MATERIALS AND METHOD

A monocrystal is put on a rotative table on a goniometric system and near it on put a film (f). The rotation ray which crosses through an aperture is reflected by the surface of the crystal and will act on the film. Rotating the crystal, under corresponding angles for Bragg conditions, we will get on the film different lines corresponding to maximums of interference. Bragg method implies the growth of big crystals. To study also monocrystaline systems we used an analogues installation, but we replaced the monocrystal with tablets got through comprimation of crystalline powder on a support. In this case, microcrystal have all orientations in space, so the reflexion will be produced in all directions and on the film from the installation; on can see interference figures corresponding to all surfaces orientations of the crystal, and the θ angles which show the position of those figures we can conclude in the act of the structure of microcrystal.

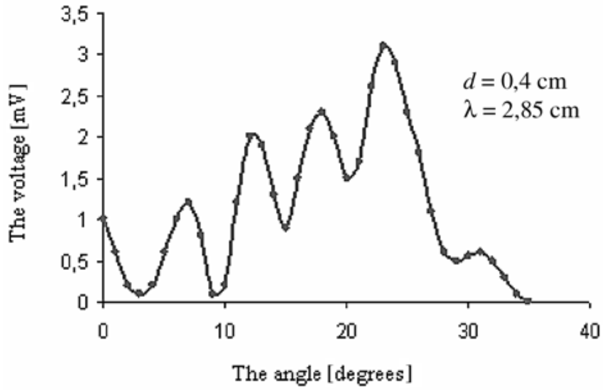
EXPERIMENTAL RESULTS

The fixed receiver from the goniometric system is rotated till we get the first maximum and we make the same operations for different angles. We repeated this operation for different angles. We register data and process and finally we get maximum and minimum values corresponding to the angles.

For the experimental set up on use two models:

– $d = 0.4$ cm, $\lambda = 2.85$ cm

– $d = 4$ cm, $\lambda = 2.85$ cm.



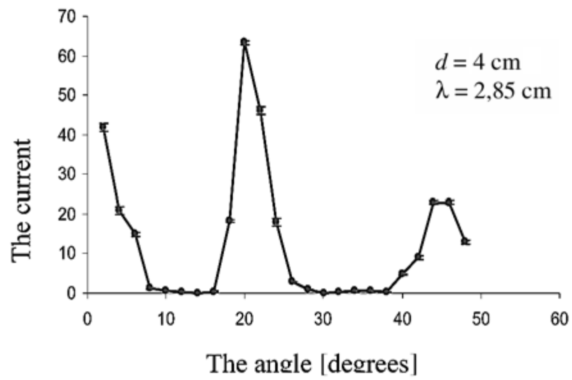


Fig. 4 – The Bragg diffraction.

CONCLUSIONS

The paper presents an experiment for students to understand Bragg diffraction on Microwaves.

REFFERENCES

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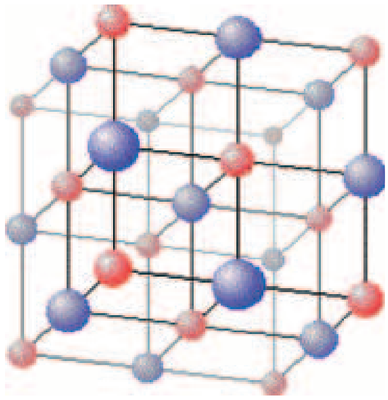
Fig. 1 – The structure of NaCl.



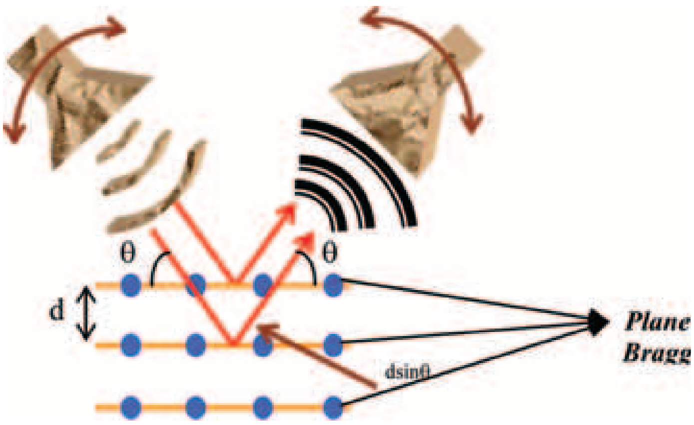


Fig. 2 – Study of microwave Bragg diffraction.

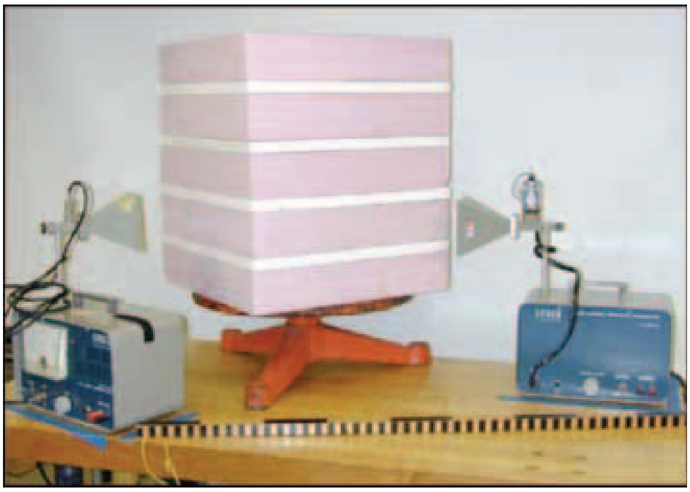


Fig. 3 – The experimental set up used to study Microwaves Bragg diffraction.