MANY-FIELD THEORY FOR CRYSTALS CONTAINING PARTICLES WITH ROTATIONAL DEGREES OF FREEDOM

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In many dielectric crystals the atom clusters are put together to form a lattice and the forces that hold the clusters together are usually much weaker compare to inter-cluster forces. It is natural to assume for such crystals that atom clusters are rigid that is to neglect the high-frequency inter-cluster vibrations. Position of a finite size cluster is defined not only by the displacement vector but also by the orientation angles. The coupling of the translational and rotational degrees of freedom may result in appearance of the soft optic modes and in many other interesting effects. Media with the microscopic rotations can be described by the so-called micropolar continuum [1].

We consider a discrete two-dimensional model of a crystal with particles having rotational degrees of freedom proposed by Ishibashi and Iwata [2]. In our recent work [3], a micropolar-type continuum theory has been constructed for this model and the dispersion relations for discrete model and continuum approximation have been compared. It has been shown that the dispersion relations for the continuum model give a good approximation of that for the discrete model only in the long-wave region. In the present work we construct the so-called many-field theory in order to improve the approximation of the dispersion relations in the whole Brillouin zone.

We consider a one-dimensional problem of compression wave propagation in order to compare the many-field micropolar theory with the micropolar theory derived in [3].

