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Title(English)	Experimental Study on Dynamic Melting of Driven Vortex Matter
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This thesis studies the issues related to the melting of crystals, which is one of the most commonly observed phenomena in nature. I study two-dimensional vortex lattices in superconducting amorphous Mo_xGe_{1-x} films, focusing on the melting caused by strong quantum fluctuations and that of highly anisotropic lattices. To remove pinning effects that could degrade the lattice structure and to observe the intrinsic melting of the lattices, I employ a mode-locking (ML) technique, which enables us to detect melting of driven lattices decoupled from the underlying pinning potential.

In type-II superconductors, equilibrium vortex states in the field-temperature ($B-T$) plane have been extensively studied since the discovery of high-T_c superconductors. While melting of the vortex lattice with increasing T and B has been well established, the true vortex-lattice melting, as well as the vortex phase diagram, in the limit of $T=0$, where quantum fluctuations play a role, remains unclarified experimentally despite its fundamental importance. This is because the pinning effect unavoidably contained in actual samples is more effective at lower T and causes the order-disorder transition (ODT) of vortex matter associated with the peak effect at B_p, where B_p is determined from a peak in the depinning current or the pinning force. This masks the observation of the true melting transition of the vortex lattice. To overcome this difficulty, in previous work, our group performed the ML measurement which enables us to probe melting of the moving lattice decoupled from the underlying pinning force. However, the ML measurement could not be conducted at low enough T, because the vortex motion generates heat. Thus, in this work I develop and conduct a *pulsed* ML measurement that produces much less heat than the previous one.

I determine, for the first time, the dynamic melting field $B^{\infty}_{c,dyn}(0)$ for the driven vortex lattice in the limit $T\to 0$, thus completing the dynamic as well as the static vortex phase diagram over the whole B and T range. I find that $B^{\infty}_{c,dyn}(0)$ is close to but definitely larger than the ODT field $B_p(0)$. This is in contrast to the previous expectation that $B^{\infty}_{c,dyn}(0)$ may coincide with $B_p(0)$. Then, I map out an *ideal* vortex phase diagram at equilibrium in the *absence* of pinning at $T=0$ as a function of B and show how the introduction of weak pinning changes the vortex phase diagram.

Since the amorphous Mo_xGe_{1-x} film is a typical, conventional type-II superconductor with weak pinning, the results obtained in this work, i.e., the whole $B-T$ phase diagrams with and without pinning, are helpful to understand the vortex states of a variety of superconductors. From an experimental point of view, the pulsed ML technique developed in this work is our original. It will be widely used to detect the dynamics of the fast driven vortex matter and, more generally, elastic object over the substrates that may generate large heat.

Another interesting question regarding the melting phenomenon is to what extent the melting condition is altered when a large anisotropy is introduced into the crystal. However, previous studies focus on the melting of materials with an isotropic crystal structure, because it is difficult to prepare materials whose anisotropy in crystal structure can be changed significantly and in a controllable manner. In this thesis, I study this issue using two-dimensional vortex lattices formed under tilted magnetic field. To remove the pinning effects, which mask the observation of the true melting transition of the vortex lattice, and to obtain the information on the lattice shape and orientation with respect to the flow direction, I again use the ML technique.

It is found that the vortex lattices in tilted field are stretched in the tilt direction and that, with increasing the dc velocity, the shape and orientation of the driven lattice change. Associated with this structural change, the dynamic melting field at which the driven lattice melts also changes. Regardless the lattice shape and orientation, the dynamic melting occurs as the shorter side of the distorted lattices reaches a side at which the isotropic lattice melts dynamically. To the best of our knowledge, this work is the first experiment to clearly show the melting condition of the highly anisotropic lattice.