Abstract

In this work, we investigate the full viscous quantum hydrodynamic model. First, real powers of operators, fractional Sobolev spaces and analytic semigroups are introduced. Additionally, we give a relation of the analytic semigroup, based on the Laplace operator, to the fundamental solution of the heat conduction equation. Using analytical semigroups and fractional Sobolev spaces, as well as the Gagliardo-Nirenberg inequality, we show the existence of mild solutions to the viscous quantum hydrodynamic equations with an additional barrier potential, under the assumption of rather general initial conditions and special initial conditions. We further show that these solutions are Hölder continuous and continuously differentiable. We conclude the analytical consideration with the linearized system and the stability analysis of stationary solutions, whereby we show instability of the full viscous quantum hydrodynamic system for large current densities. In the second part of this thesis we explain the discretization of derivatives and the continuation method using a predictor-corrector scheme. The time dependent, spatially discretized problem is solved by backward Euler time integration and we give a numerical solution for a voltage of $0V$. Finally, we present solutions to the stationary system and the current-voltage characteristic.