Abstract

The work presented in this dissertation is focused on surface and self-assembly properties, and microstructure formation in aqueous or organic solvents by some novel single-tailed amphiphilic molecules synthesized from amino acids or amino acid derivatives. For aggregation studies in water, the amphiphiles employed include sodium N-(4-n-alkyloxybenzoyl)-L-histidinate (C_n-OBH, n = 6-12), an amino acid-derived zwitterionic surfactant, and (3-Alkylcarbamoyl-2-hydroxypropyl)-trimethylammonium chlorides (C_n-CAR, n = 12-16), a cationic surfactant of carnitine salt. Different techniques such as, surface tension, conductivity, dynamic light scattering (DLS), fluorescence spectroscopy, circular dichroism (CD), and optical and electron microscopy were used to study the self-assembled structures. The C_8-OBH amphiphile showed pH responsive aggregation behavior and vesicle formation in solution of pH 8.0 to 12. The C_n-CAR surfactant was also characterized as vesicle-forming in dilute aqueous solutions. In the presence of cholesterol the vesicle size and stability was observed to increase. Effects of salt, surfactant concentration, and temperature on the vesicle formation were investigated with or without varying amounts of cholesterol. The gene transfection efficiency of C_{12}-CAR was evaluated and compared with that of commercial liposome, lipofectamine. The C_n-OBH amphiphiles were also observed to form thermoreversible hydrogels in a wide range of pH. Among the amphiphiles, C_8-OBH showed better gelation ability in the studied pH range. For aggregation studies in non-aqueous media a new class of amino acid-derived amphiphiles, N-(4-n-alkyloxybenzoyl)-L-alanine (C_n-OBA, n = 8-16) was designed and synthesized. These amphiphiles were shown to form thermoreversible gels in organic solvents, at room temperature. The effects of amide functionality, chain length of the hydrocarbon tail, and the chirality of the head group of the amphiphiles on the ability to promote gelation in organic solvents were studied. The C_{14}-OBA derivative showed the best gelation ability. The mechanism of gelation was studied using ^{1}H NMR and FTIR spectroscopy. Hydrogen bonding between -COOH groups as well as π–π interactions were found to be important for the gelation process. The structural variations of the gels were characterized by critical gelation concentration (CGC), gel melting temperature (T_{gs}), rheology, and scanning electron microscopy.

Keywords: self-assembly, amino acid-based amphiphiles, vesicle, hydrogel, organogel