CHAPTER I
INTRODUCTION

Asphaltenes are the class of extremely polydispersed materials existed in petroleum crude oil (Permsukarome *et al.*, 1997). They are typically composed of condensed polynuclear aromatic rings, traces of heteroatoms (S, N, and O) and small amounts of metal content such as nickel and vanadium (Durand *et al.*, 2009, Luo *et al.*, 2010). Due to a difficulty to identify their complex chemical structure, asphaltenes have been defined based on their solubility as the components which are soluble in aromatic solvents (e.g. toluene) and insoluble in aliphatics (e.g. n-heptane) (Mullins *et al.*, 2012). Changes in pressure, temperature and/or composition during oil production and refining processes induce the destabilization of asphaltenes (Garreto *et al.*, 2013, Hoepfner *et al.*, 2013). Once destabilized, asphaltenes tend to aggregate into clusters, precipitate and eventually deposit in pipelines and reservoir wells causing the reduction in oil production capacity (Mutelet *et al.*, 2004, Poveda *et al.*, 2014)

For decades, numerous studies have been therefore trying to understand destabilization and precipitation mechanism of asphaltenes using various characterization techniques to identify the properties of the most unstable asphaltenes portion in crude oil. In the past, most of the works regarding asphaltene characterization believed that asphaltenes precipitation is a solubility-driven process. However, it has been established that asphaltenes precipitation is a time dependent process (Maqbool *et al.*, 2009). It has also been proposed that the earliest precipitated asphaltenes are expected to be the most problematically unstable asphaltenes which could cause the severe problems in oil production.

Extensive works have investigated the properties controlling the aggregation kinetic of asphaltenes. They found that difference in asphaltene concentrations and polydispersity of asphaltenes have strongly influence on their precipitation kinetics (Haji-Akbari *et al.*, 2014). However, the role of polydispersity on asphaltene precipitation has not been clearly investigated. Therefore, the aim of this work is to probe the role of asphaltene polydispersity on their aggregation behavior using time-based fractionation along with solubility-based fractionation to separate asphaltenes into sub-fractions. In this study, microscopy experiment and small angle X-ray scattering were used to observe aggregation tendency and measure nanoaggregated sizes of all asphaltene sub-fractions, respectively.