Direct conversion of methane into fuels and platform molecules has been for a long time a "holy grail" in chemistry. The high C-H bond energy (434 kJ mol^{-1}), absence of functional groups and of the polarity result in a very low methane chemical reactivity. In recent years, methane has become increasingly abundant due to the development of shale gas fields and other cost efficient or renewable feedstocks such as biogas. High temperatures and high pressures are generally required to accelerate methane chemical transformations and operation at practical rates. These harsh conditions, however, lead to huge energy consumption, often-important emission of CO_2, parasitic formation of by-products and fast catalyst deactivation. Solar light is an ideal alternative energy source and is largely used in combination with semiconductors to drive chemical reactions. Recently, we found exceptional performance of metal heteropolyacid nanocomposite supported on TiO_2 in methane coupling to ethane and propane at room temperature. This new photochemical system was developed on the basis of heteropolyacid-TiO_2 composites, already employed by the UCCS team for photocatalytic selective oxidation of methane to CO. The reaction occurs according to the radical mechanism and involves metal species highly dispersed on heteropolyacids. The Ag based systems showed exceptionally high activity and selectivity to ethane. The maximum selectivity to ethane under these conditions reaches 90%. The regeneration in the presence of irradiation in air results in reversible oxidation of silver small metallic clusters into silver cations. The process can be conducted continuously using "photochemical looping". The obtained yield of ethane from methane under these conditions is close to 10%. Within the SolarMethaChem project we are aiming to study and optimize this process. Thus the major goals of this project are *i)* the nanoengineering of new efficient materials for efficient oxidative coupling of methane to ethane and higher hydrocarbons, *ii)* identification of the reaction mechanisms of methane coupling and *iii)* optimization of the photochemical reactor and operating conditions. Three research groups in France (Partner 1, CNRS-UCCS), Finland (Partner 2, University of Helsinki) and Poland (Partner 3, Jerzy Haber Institute of Catalysis and Surface Chemistry PAS) with complementary expertise in catalysis, materials science and modeling will carry out the project. The SolarMethaChem project is planned for 3 years and contains 5 work packages (WPs). The primary focus of the study is the photochemical conversion of methane (WP2), with an emphasis on the combination between material engineering (WP1), advanced characterization (WP3), and theoretical modeling (WP4). The project involves recruitment of 3 postdoctoral researchers with complementary competences in these areas.