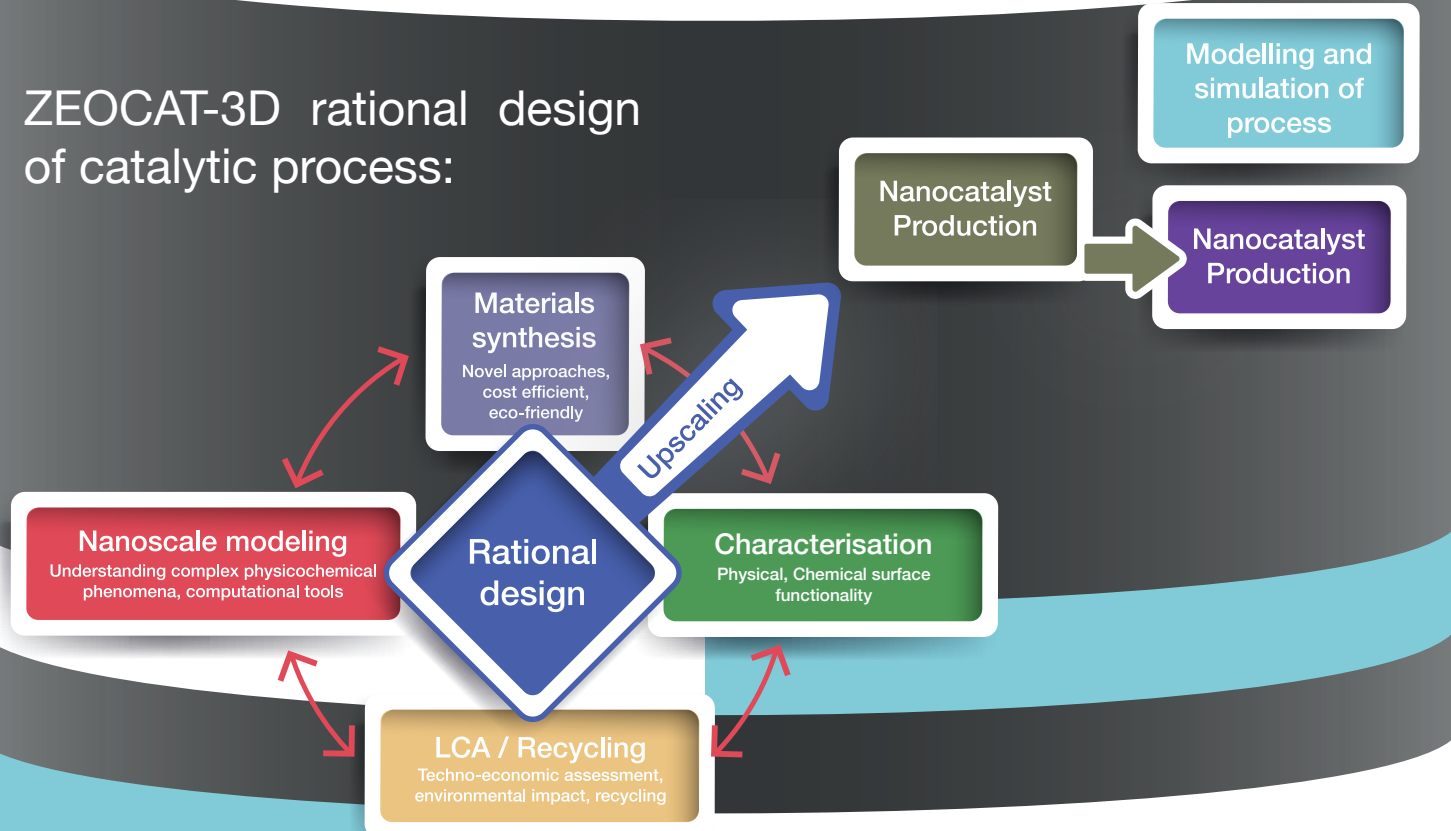


ZEOCAT-3D rational design of catalytic process:



Development of a bifunctional hierarchically structured zeolite based nano-catalyst using 3D-technology for direct conversion of methane into aromatic hydrocarbons via methane dehydroaromatization.

The consortium is composed of seven SMEs and 7 research centers covering five main groups of competences: 1) Supply of raw materials (biogas/gas natural), 2) Optimization of multiscale modelling, 3) Optimization and development of catalytic material and 3D-printing process, 4) Design and optimization of upstream and downstream components and prototype of MDA reactor, and 5) Specialized processes assessment.






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Although the natural gas reserves in Europe and in the world are still growing, a high percentage of these reserves are classified as stranded because shipping gas is uneconomical, and the costs of liquefaction or building a pipeline are excessively high. The conversion of methane from this and other sources like biogas into shippable high valuable liquids can solve these problems but in some cases the capital costs of current industrial multi-step conversion routes represent a limitation.

Therefore, this project aims at establishing alternative direct and cost efficient routes through the development of radically new 3D hierarchical structured catalysts with bi-functional activity (two types of active centers), achieving multimodal pore size distribution (micro-, meso1-, meso2-, macro-porous) and high dispersion of metal active sites that will allow for:




-  Effective control on the product selectivity,
-  Easy regeneration and avoidance of coking and
-  Increase of the reactor productivity for the process of direct methane dehydroaromatization (MDA) into high value chemicals such as aromatics (benzene, naphthalene, among others).

Problems related to low methane conversion, low selectivity towards the desired products, and the quickly deactivation due to carbon deposition onto catalyst will be overcome by the use of hierarchical zeolites structures synthesized by 3D-printing and loaded with doped molybdenum nano-oxides.

Challenges of the MDA process	Effect	Expected results
Difficult activation of the C-H bond of CH ₄ molecule	Low methane conversion	Improved methane conversion (>50%)
High reactivity of the products compared to methane	Low selectivity towards the desired products	Increased selectivity towards benzene (>90%)
Acid sites of zeolites are occupied by coke deposition	Deactivation of catalyst	<ul style="list-style-type: none"> - Enhanced performance (7 times less deactivation) - Higher yield rates (up to 80%)

The methodology of the project will go from laboratory to pilot scale demonstration in a real environment. Catalyst design and operation conditions will be optimized for different methane feedstock at lab-scale and then upscaling and construction of a final prototype will be carried out.

Specific objectives of ZEOCAT-3D:

-  Development and production of improved catalyst
-  Design, construction and validation of catalytic reactor
-  Rational design of catalyst/multi-scale modelling