



جامعة الملك فهد للبترول والمعادن
King Fahd University of Petroleum & Minerals

King Abdullah University of
Science and Technology



Transformative Research in Petrochemicals and Polymers

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Petrochemicals & Polymers: Global Scenario



Structural Changes in Global Petrochemical and Polymer Industry

- Paradigm shift from west (North America and Western Europe) to East (Middle East and Asia Pacific)
- Global demand for petrochemicals is growing at 5-6 % per year

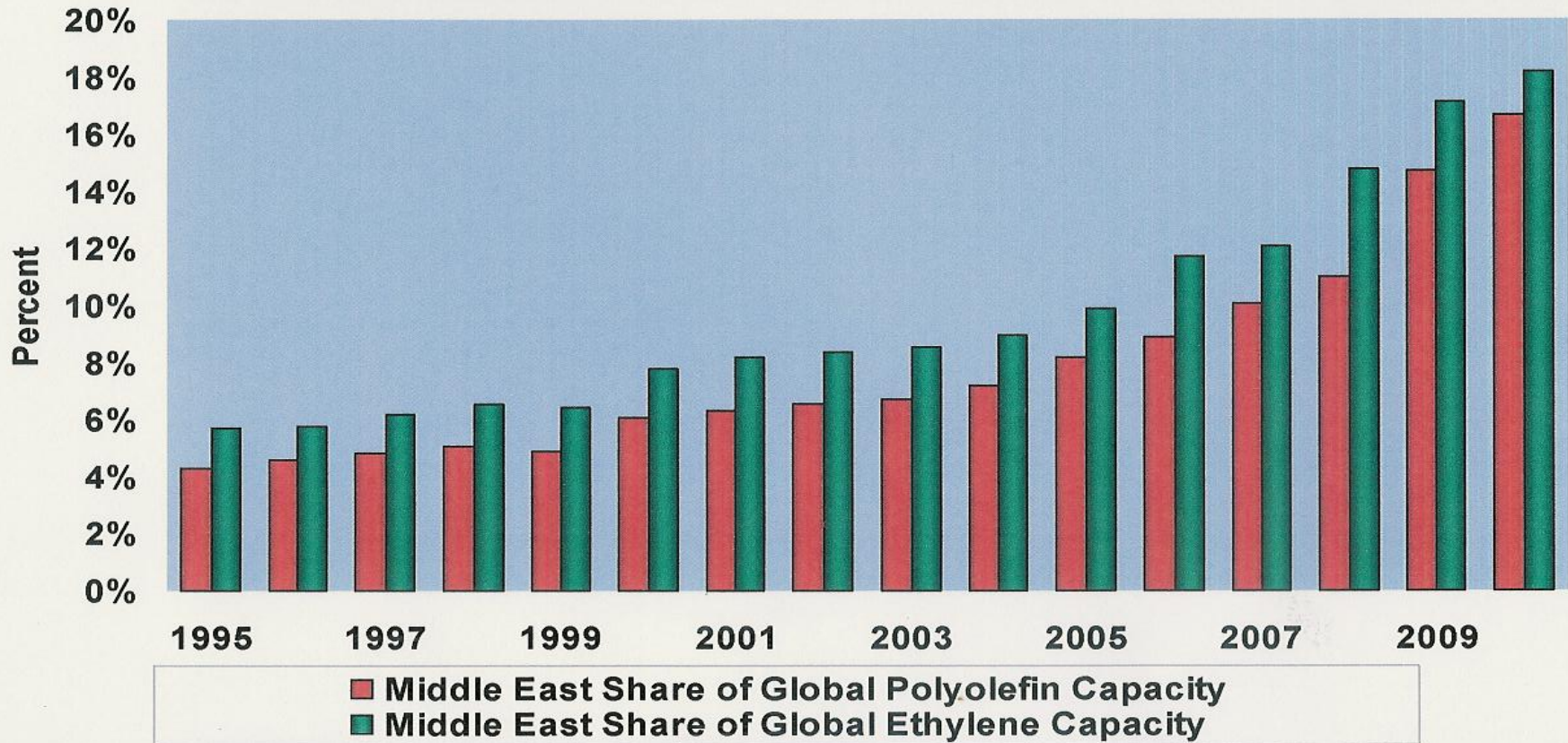
Current Challenges of Global Petrochemical and Polymer Industry

- Changing feedstocks
- Cost and availability of energy
- Varying consumer demands
- Crisis of talented manpower

Need for innovative technologies to face these challenges



Petrochemicals & Polymers: Global/Middle East Scenario



**Market Share of Petrochemicals from Middle East
Increasing Significantly and Rapidly**



Petrochemicals & Polymers: Saudi Arabian Scenario



Saudi Arabia to be a global leader in petrochemical industry

- Kingdom will be world's third largest in petrochemicals production by 2015
- Refining and petrochemical Integration – the next big leap

Factors influencing expansion of petrochemical industry

- Significant value-addition from economies of scale
- Cost-advantaged feedstocks (gas and gas liquids)
- Product diversification regardless of feedstock scenario
- Excellent infrastructure for energy distribution and other services

Access to technology: Develop or adapt?



Vision and rationale of KAUST CID at KFUPM



Vision

- Establish a world-class petrochemicals and polymers research center with particular relevance to Saudi Arabia's strategic needs

Rationale

- Saudi Arabia's world market share of petrochemicals will increase from the current 8% to 15% within next decade
- Strategic need to develop process technologies that provide cost and performance advantage
- KAUST and KFUPM share the quest for scientific and research excellence



Mission and objectives

Mission

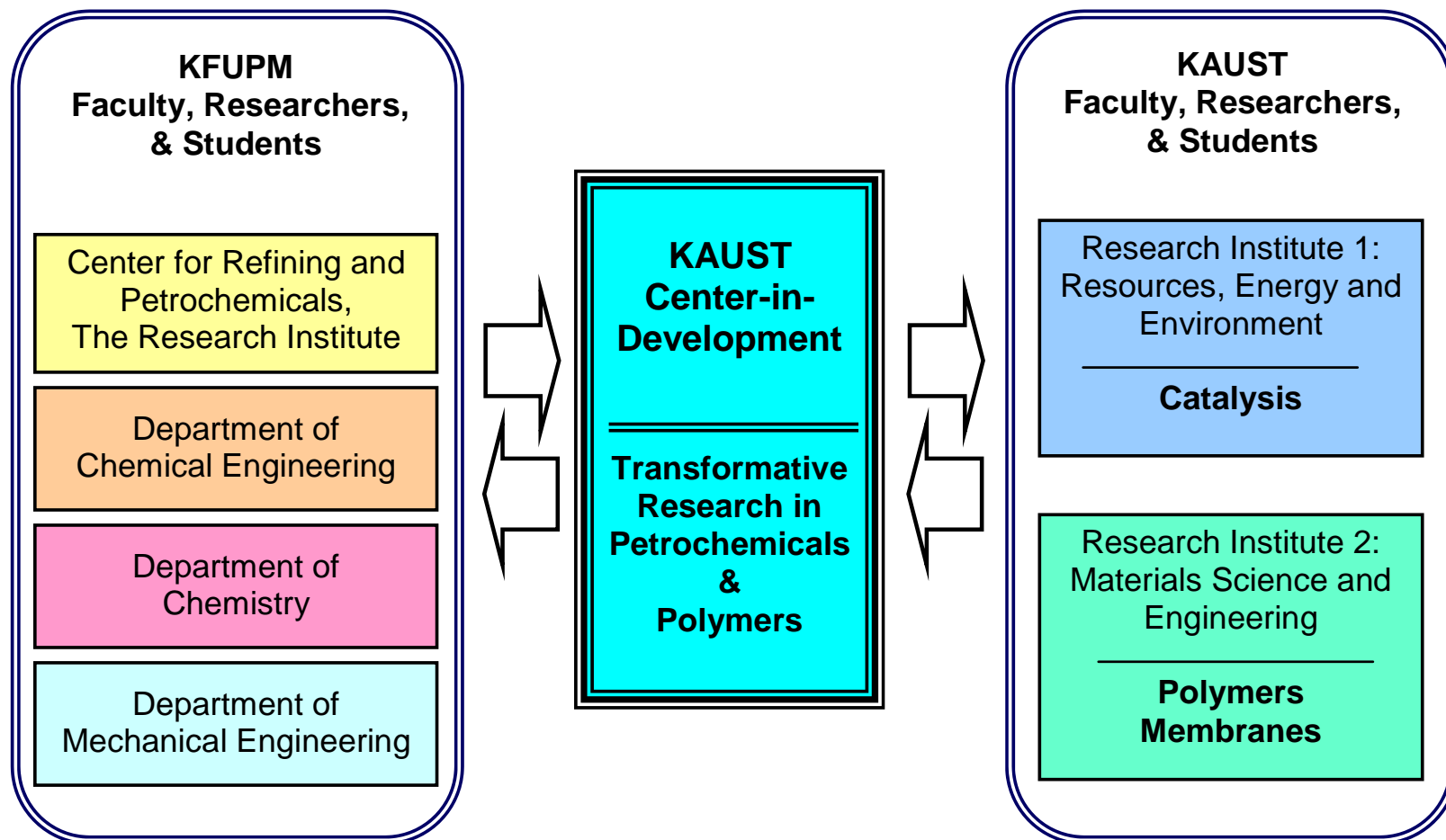
- Conduct high-quality R&D and offer world-class graduate study and training in petrochemicals and polymers

Objectives

- Establish focused research programs aimed at generating novel concepts leading to higher value-added products
- Strengthen graduate education in the areas of the center's research concentration
- Promote cooperation in research by strengthening domestic and international research collaborations
- Achieve an excellent level of research management to compete for a KAUST Center after the 3-year CID award period



KAUST-KFUPM multidisciplinary interaction





Educational plans

- Provide graduate students and post-doctoral fellows an opportunity to participate in challenging R&D projects
- Faculty / graduate students at KFUPM and KAUST will have unique opportunities for intellectual cross-fertilization
- Students will co-work with international collaborators
- Hold workshops and technical seminars





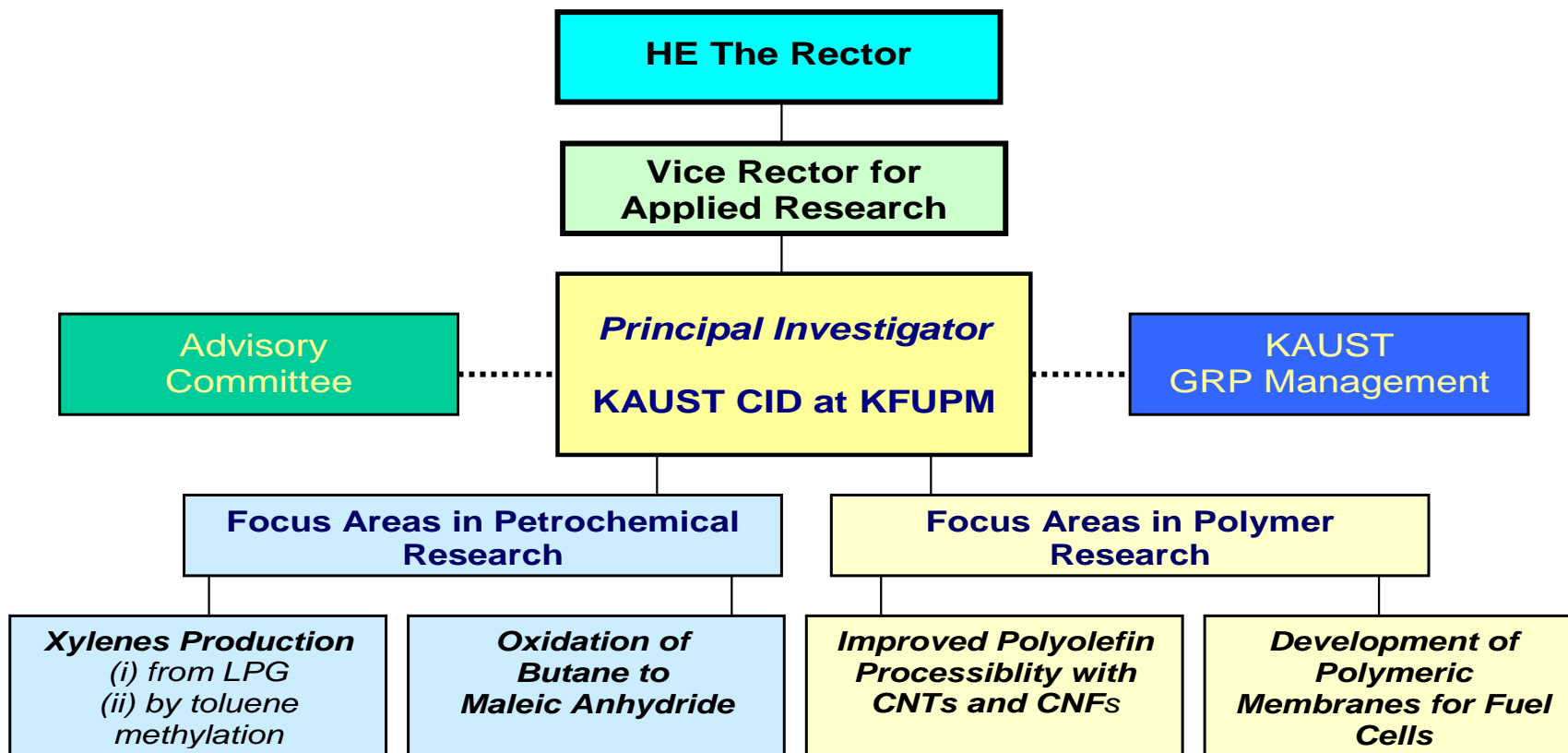
Collaboration with industry

- KFUPM's long standing and strong interaction with industry will be utilized
- Saudi Aramco's Letter of Intent to cooperate with KAUST CID
- Benefits of collaborating with industry for KAUST CID include:
 - Obtaining important information about research areas
 - Facilitating the transfer of research results from laboratory to industry
 - Accelerating the commercialization of new technologies



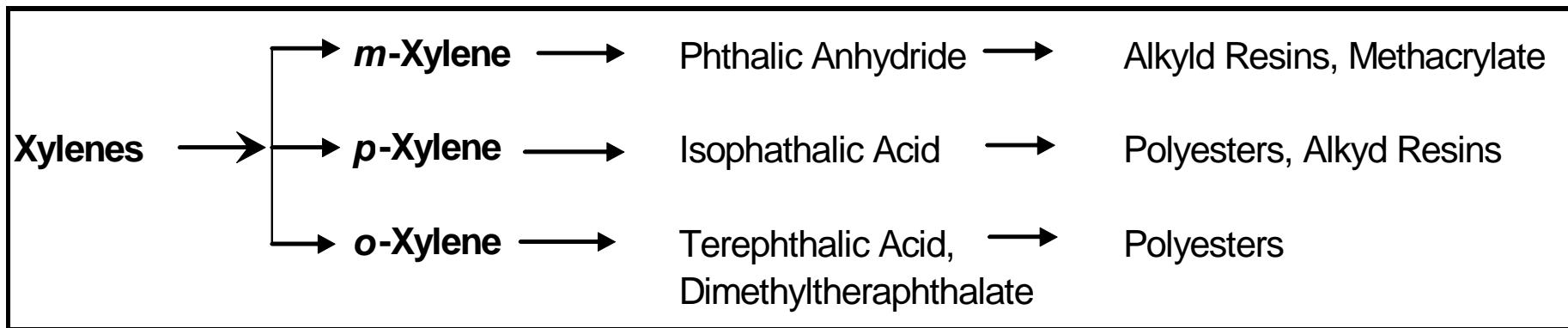
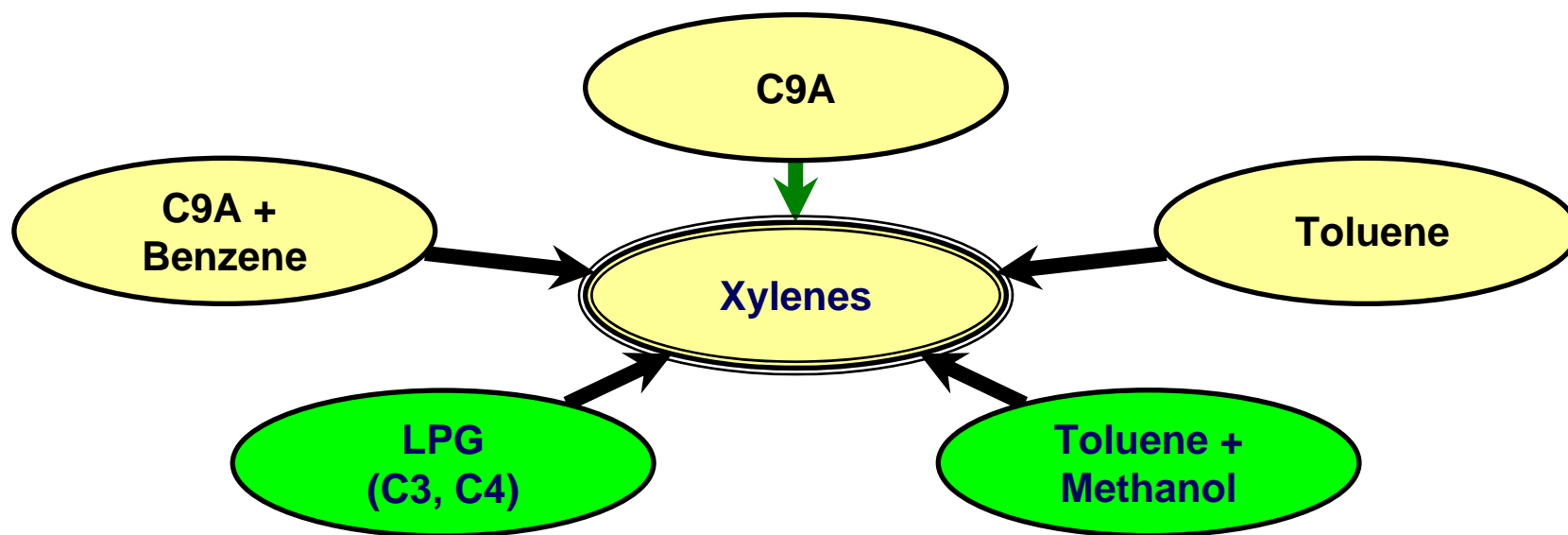


Organization chart

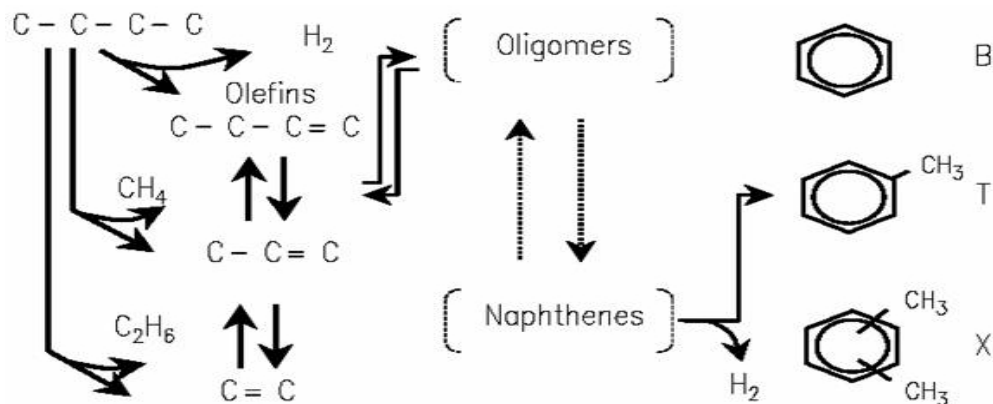


- R&D team is made up of qualified and experienced researchers and faculty members
- Renowned experts will be invited as consultants for different focus areas

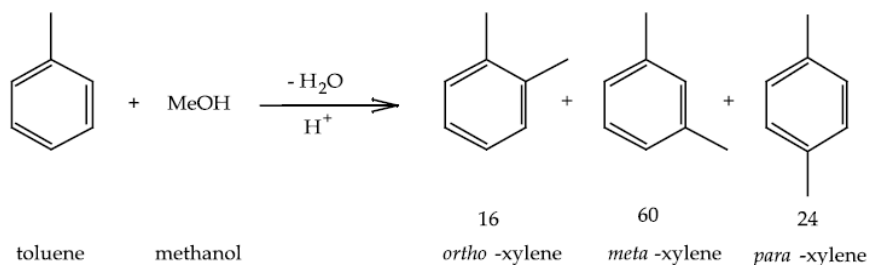
Routes to produce xylenes and its applications



From LPG



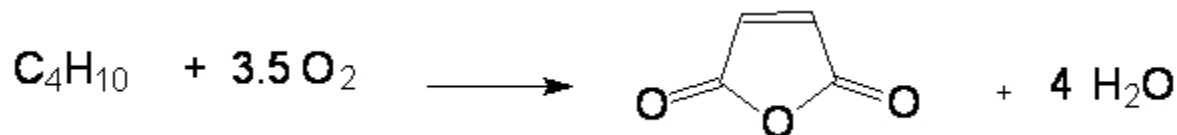
From toluene methylation



Highly active catalyst development will be the key focus



Partial oxidation of butane to produce maleic anhydride

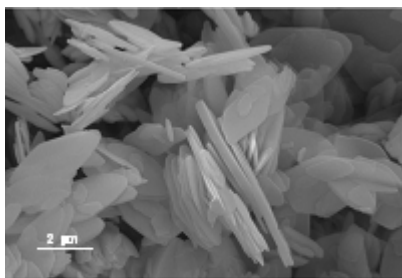
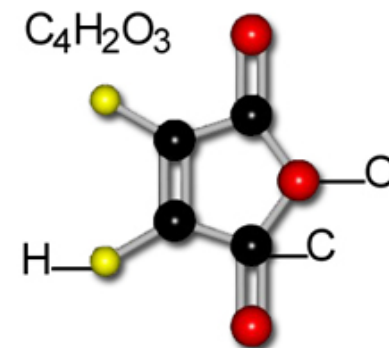


Applications

Unsaturated polyester resins, tetrahydrofuran, fumaric acid, alkyd resins, and pesticides

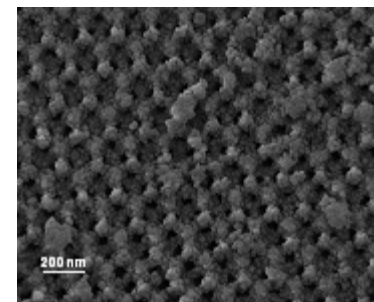
Objectives

Develop high surface area nanosized vanadium phosphorus oxide (VPO) catalysts transformation of *n*-butane to maleic anhydride



Conventional unsupported, low surface area VPO.

Objective



New, nano-sized and high surface area supported VPO



Enhancing the processability of polyolefins by using carbon nanotubes and nanofibers

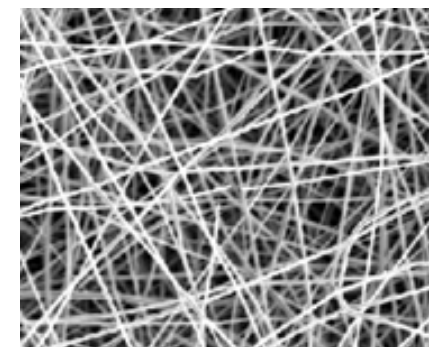


Objectives

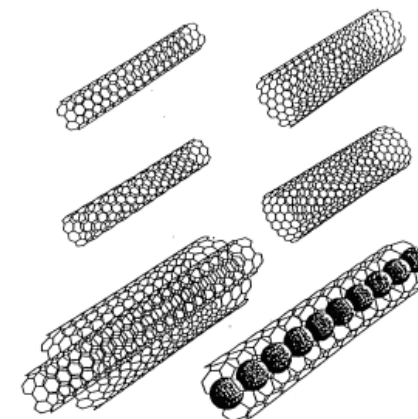
- To explore use of CNT/CNF as additives for enhancing the processability of polyethylene
- To assess the improvement by shifting of sharkskin behavior of polyethylene resins

Expected Outcome

- Identification of CNT/CNF type and ratio leading to enhancement in the processing of polyethylene
- Outcome of this project will lead to an increase in the production rate of plastics and energy saving



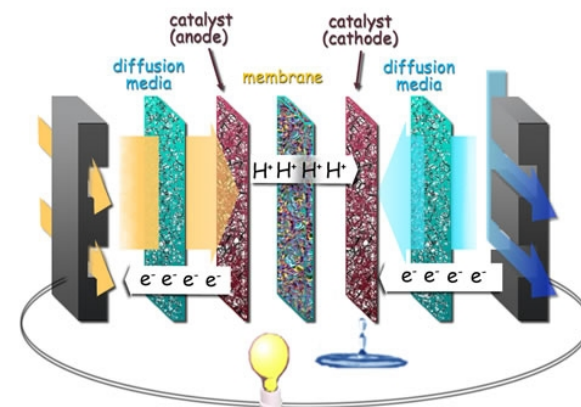
Carbon Nanofibers



Carbon Nanotubes

Background

- Direct methanol fuel cells (DMFC) provide clean power from renewable fuels
- Efficient polymeric electrolytic membrane is core component of the DMFC to prevent crossover of methanol



Objectives

- Development of novel polymeric membranes for DMFC
- Characterization of membranes for thermal stability, conductivity and morphology
- Performance evaluation of membranes



Necar 3 is powered by 50kW of fuel cells, which are supplied with hydrogen from an on-board methanol reformer

Fuel Cell Powered Car



Outcomes and benefits

Outcomes

- Novel catalysts systems and processes
- Build research expertise and develop specialized facilities
- Establish links with international institutions
- Publications and intellectual properties

Benefits

- KAUST: Collaboration in strategic areas by faculty/student exchange
- Regional: Utilization of abundant raw materials for value-addition
- National: Building research capacity and support economy
- Global: Developing international collaboration & technology transfer