ACCELERATORS USE TO ENGINEER NANO-MATERIALS FOR ENERGY

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It is known for more than 2000 years that Damascus swords' performances were not possible without the existence and usage of the "Damascus steel", the first man made nano-hetero structural material that generalized is clearly showing that materials determine ultimate properties of the objects that made off. The actual nuclear energy has lower CO_2 emission, but because it is in its infancy, it is based on homogeneous "hot-rod" technology, it is complex, expensive and raises security and proliferation issues, has the potential for large scale accidents, and generates difficulties in dealing with waste fuel dispositioning.

The novel developed families of engineered nano-materials, eliminate almost all the drawbacks of the actual nuclear power, rendering it among the most efficient and environmental friendly energy source. Developing and optimizing these novel energy materials require intensive accelerator use in fundamental knowledge development and structural optimization experiments.

The novel nuclear materials as shown in Fig. 1, were developed in 6 families; each of them is intended to bring in harmony the structure with a nuclear agent active inside that material as:

- Micro-hetero structures, generally called "cer-Liq-Mesh" that self-separates the fission products from the nuclear fuel and minimizes their fuel damage, allowing breed&burn to near perfect burning; the fission products behave like medium mass accelerated ions, where the use of accelerators will help test the novel material structure and optimize it.
- Nano-hetero structures generically called "CIci", that form a super-capacitor, charged by nuclear energy and directly discharged as electricity; This structure has broad use for almost all moving nuclear particles except neutrons and gamma, and for each type of particle, the use of a similar accelerated one bring a valuable contribution to material selection and optimization as well to the entire structure test and characterization.
- Nano-clustered structure that enhances self-separation of transmutation products; where the initial idea was generated by UTLA method development, where the recoil energy is used for implantation, but because this energy inside neutron zones is small, nano-cluster enhanced selective diffusion properties are also used. Using low energy accelerators/implanters we may test various nano-clustered structures.
- Fractal immiscible materials with radiation damage self-repairing capabilities eliminating the need for re-cladding in near perfect burning structures. The dimensions of these structures may be optimized using ion-beams simulating the radiation damage inside nuclear reactors.
- Nano-structures with active NEMS used as fast control of nuclear reactivity by guiding neutrons in desired directions or ultralight shielding for mobile reactors. The guiding is similar to radiation channelling being possible to use ion-beams to test the NEMS operation.
- Nano-structures that create active-quantum-nuclear-environment for long range nuclear reactions control by using quantum states entanglement and collective quantum states control. This is a novel development with cutting edge concepts, where we may use accelerated ion beams in order to excite collective quantum states, and study possible long range quantum leaps, entanglement and quantum state teleportation.

The use of these advanced materials in future nuclear energy related application will render a high efficiency, minimal nuclear waste, and optimal nuclear fuel cycle, isotope, fission and fusion “batteries”, delivering the needed planetary clean energy at will for the next 10,000 years, and even more.

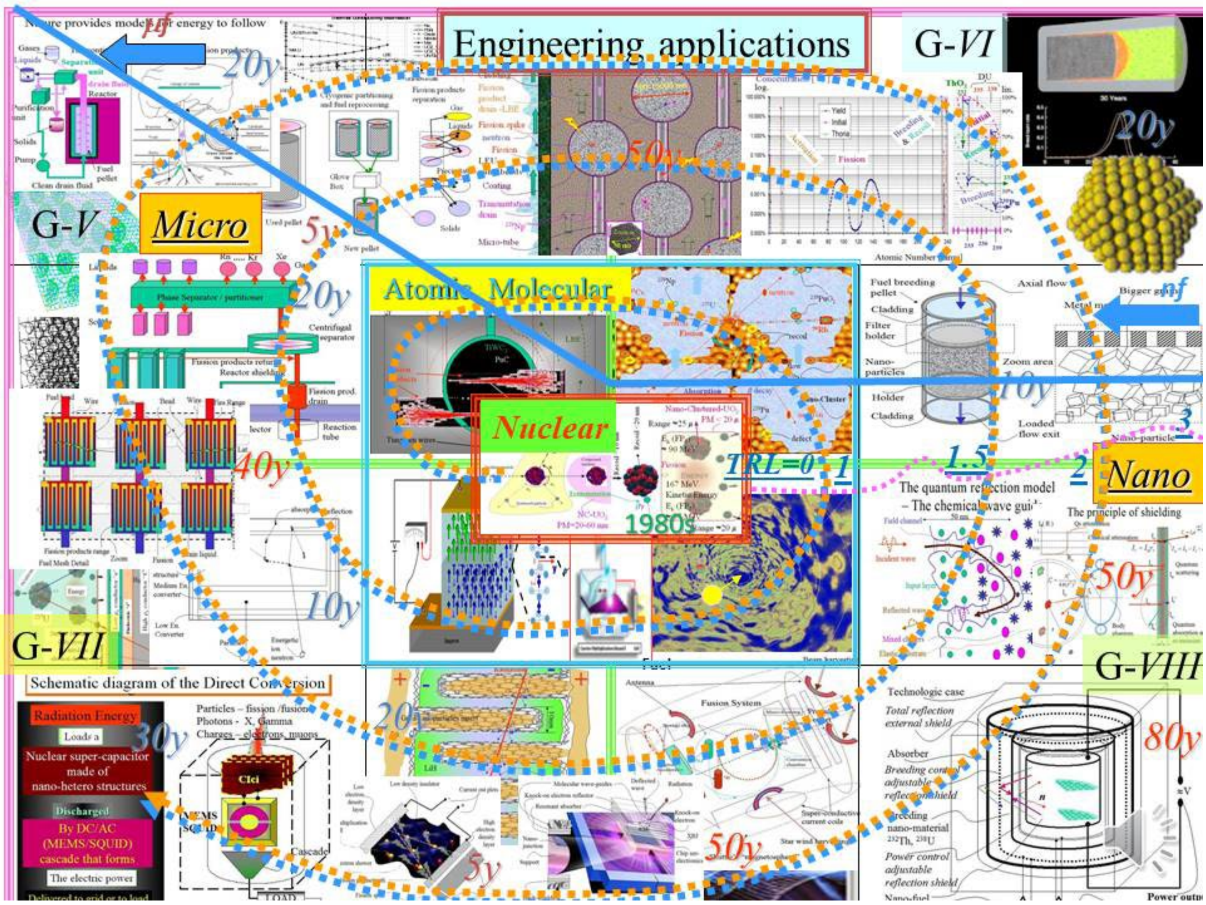

Fig. 1 Engineered, nano-nuclear materials knowledge evolution from concept to application

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