

2019 Basic Nuclear Engineering I Lecture note (2)

- Nuclear Fission -

Toru Obara

Tokyo Institute of Technology

2. Nuclear Fission

2.1 Nuclear fission by neutron

- Heavy nucleus causes fission reaction by the collision with a neutron with

very high speed

→ =with large mass number

→ Number of protons + neutrons

- Heavy nucleus with odd number of neutrons causes fission reaction by very slow neutrons
- Nucleus which satisfies the condition in nature is uranium 235 only

(²³⁵U)

Mass number

235
92 U

Atomic number

[Number of protons: 92
Number of neutrons: $235 - 92 = 143$

2.2 Actinoid

○ Actinoid : element whose atomic number is from 89 to 103

Ac Lr

○ Important actinoid in nuclear reactor

• Uranium (Atomic number 92)

Abundance in the earth's crust : 2×10^{-6}

Natural uranium	{	uranium 235 ^{235}U 0.71%
		fissile ← easy to cause fissile by neutron
		uranium 238 ^{238}U 99.29%

• Thorium (Atomic number 90)

Abundance in the earth's crust : 7×10^{-6}

Natural thorium	·····	thorium 232 ^{232}Th 100%
		non-fissile

^{232}Th : by neutron capture

transmuted to ^{233}U (fissile)

does not exist in nature

• Plutonium (Atomic number 94)

does not exist in nature

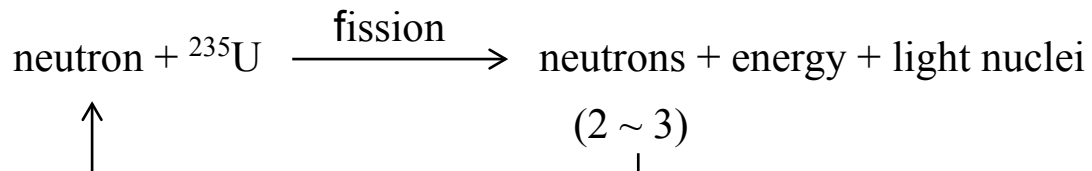
^{238}U : by neutron capture

transmuted to ^{239}Pu (fissile)

3. Nuclear fission chain reaction

3.1 Concept of nuclear fission chain reaction

By using neutrons emitted by fission reaction, causing the next fission reaction



But !!

Even if neutrons are injected to natural uranium, fission chain reaction does not occur.

(3.1. to be continued)