# Cyclotron Production of I-123 by Bombardment of $^{124}$Te Electroplated Target

Zhou Wei, Wang Yongxian, Yin Duanzhi

Shanghai Institute of Applied Physics,

Chinese Academy of Science

# Nuclear process for production of $^{123}I$

- Direct method: (low energy cyclotron)

$^{121}Sb(\alpha,2n)^{123}I$, $^{nat}Sb(^{3}He,xn)^{123}I$,

$^{124}Te(p,2n)^{123}I$, $^{123}Te(p, n)^{123}I$,

$^{122}Te(d,2n)^{123}I$ ……

- Indirect method: $^{123}Xe \longrightarrow {}^{123}I$

(medium and high energy cyclotron)

$^{127}I(p, 5n)^{123}Xe$, $^{124}Xe(p, 2n)^{123}Xe$

$^{124}Xe(p, pn)^{123}Xe$ ……

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# Te target for production of I-123

- Metal $^{124}Te$ target

  2π or 4π cooling

  wet chemical separation

- Molten $^{124}TeO_2$ target

  4π cooling

  dry distillation

# Source for $^{124}TeO_2$ lost

- Target heating to liberate $^{123}I$
  loss of $^{124}TeO_2$:<1%
- Accidental melting during irradiation
  2π cooling system
  irradiation angle: 6 °
  loss of $^{124}TeO_2$:3~5%

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# Production method
## for electroplated target

- $^{124}Te$ electroplated Target----molten target
- Irradiation
- Wet chemical separation -----dry distillation
- Recovery of the enriched tellurium
- Quality control

# Targetry
## Ni surface onto the Cu plate

- Ni plating solution:

  $NiSO_4 \cdot 6H_2O$

  $NiCl_2 \cdot 6H_2O$

  $H_3BO_3$

- pH: 3~4.

# Targetry
## Ni surface onto the Cu plate

- Current: 200mA
- Time: 12 min
- Anode: platinum electrode
- Cathode: Cu plate
- Current efficiency: 90%
- Ni thickness: 250ug/cm$^2$

# Targetry

## Electroplating of enriched $^{124}Te$

- Stock solution
- $^{124}Te \longrightarrow {}^{124}TeO_2$
- KOH solution
- pH: 10~11

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# Targetry
## Electroplating of enriched $^{124}Te$

- Current:100mA
- Time: 60 min
- Thickness: 12mg/cm$^2$
- Wash
- Dry

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# $^{124}Te$ electroplated target


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# Irradiation

- Cyclone 30 (IBA)
- Proton energy: 25 MeV
- Beam current intensity: 20~50μA
- Time of irradiation: 0.5~3hr
- $^{123}I$ yield: 8.2mCi/μA h
- $^{124}Te$ loss: <1% each run

# Separation of I-123 from tellunium

- Dissolution of $^{124}Te(NaOH + H_2O_2)$
- Aluminum power
- Heating gently
- Stream distillation
- Precipitation $(Te^0 + Al(OH)_3)$
- Filter
- Radiochemical yield : >90%

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# Recovery of the enriched Te-124

- Dissolution of power($Te^0$ +$Al(OH)_3$)
  $H_2SO_4 + H_2O_2$
- Distillation
- Hypophosphorus acid
- Precipitate of tellurium
- washed and dried
- $^{124}Te$ recovery : >99.5%

# Quality Control

- Radionuclidic purity
- Radioactivity concentration
- Radiochemical purity
- pH value
- Concentration of Al & Te
- Bacterial  endotoxins

# Result and discussion

- Target
  thickness: Ni 250ug/$cm^2$, Te 12mg/$cm^2$
- $^{123}$I yield: 8.2mCi/μA hr
- $^{124}$Te loss:  1% each run
- Radiochemical yield : >90%
- $^{124}$Te recovery : >99.5%

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# Influence of beam current intensity on loss of Te

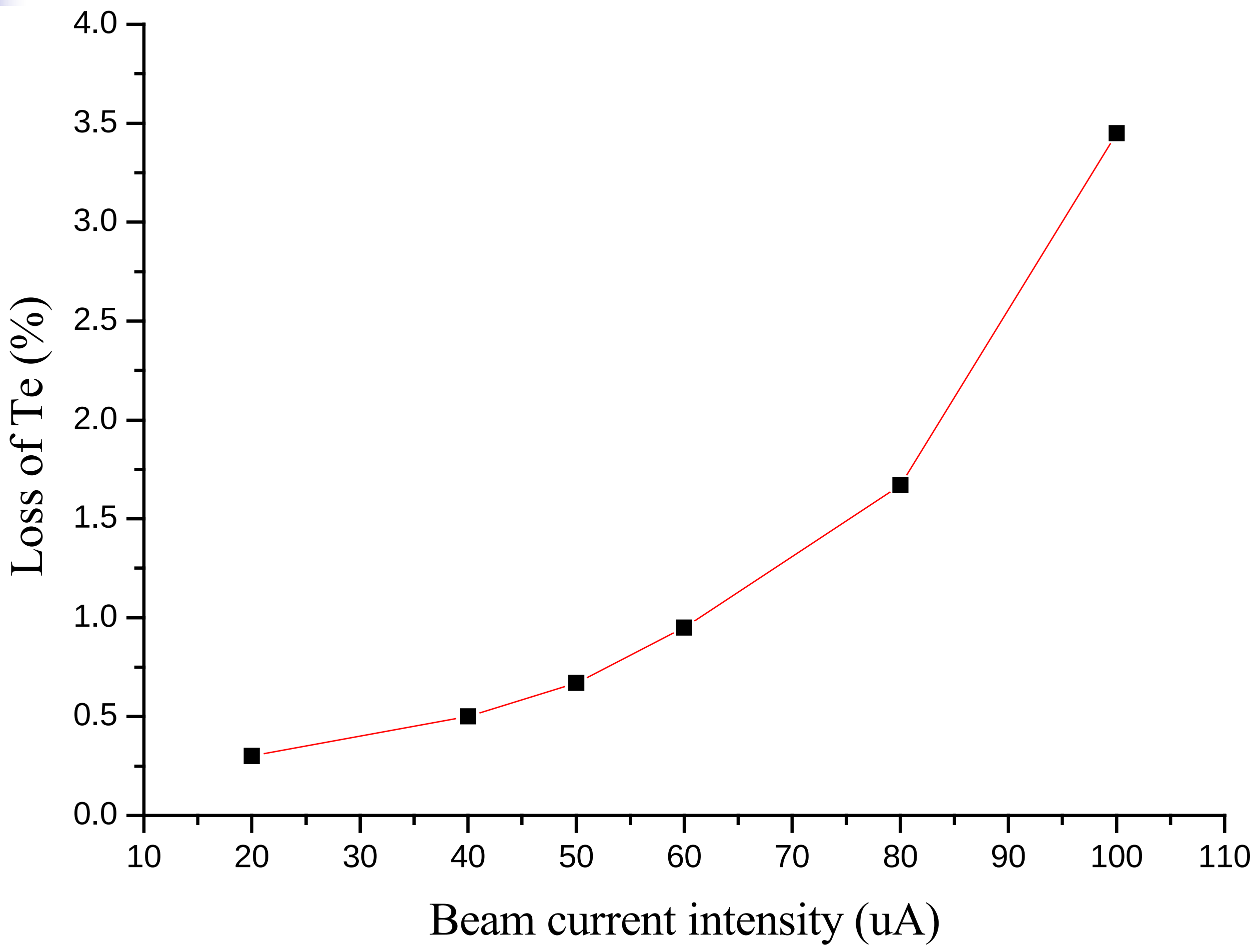


Fig.1 Relationship between loss of Te and beam current intensity

# Influence of thickness of Ni layer on loss of Te

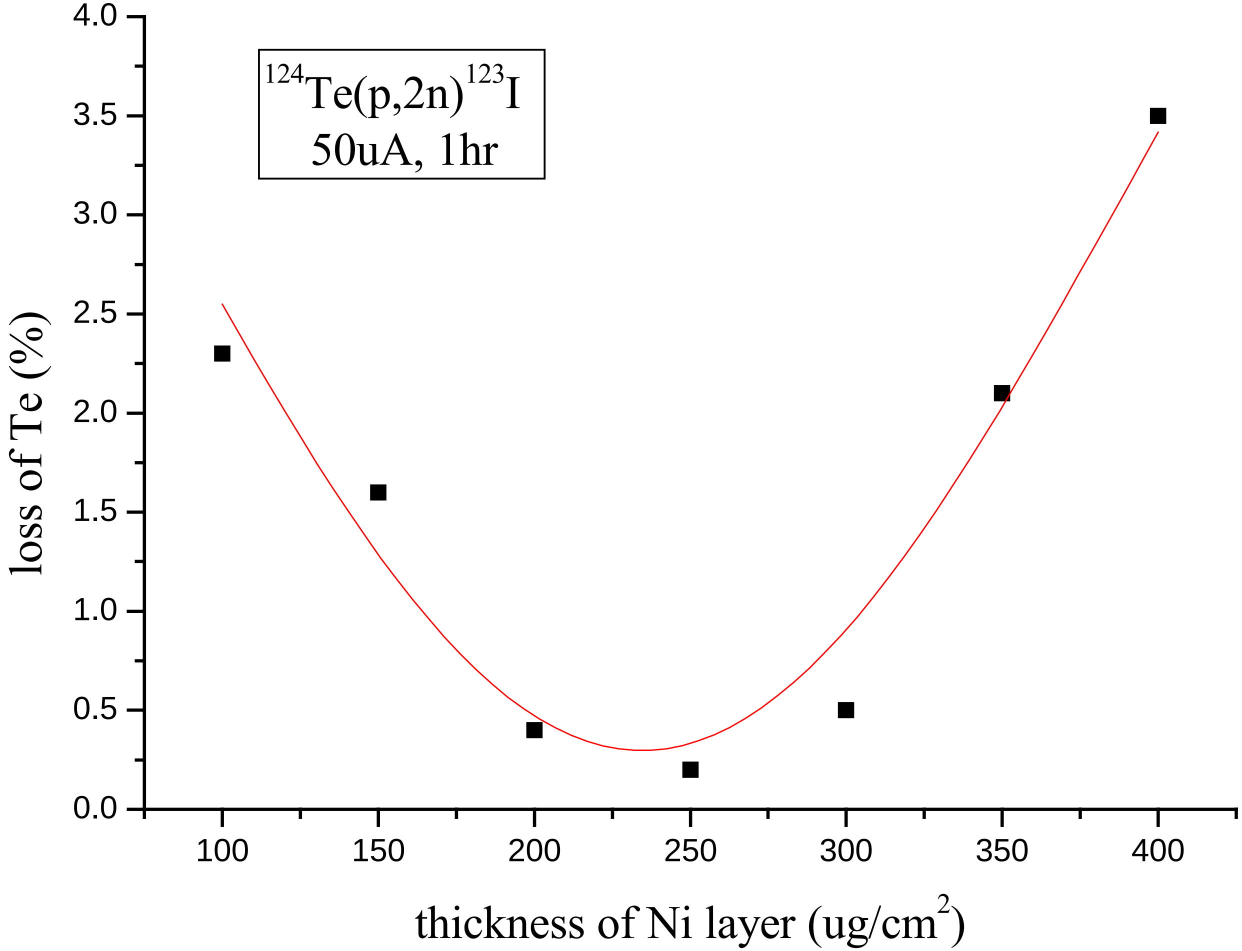

Fig.2 Relationship between loss of Te and thickness of Ni layer

# Influence of thickness of Te on loss of Te

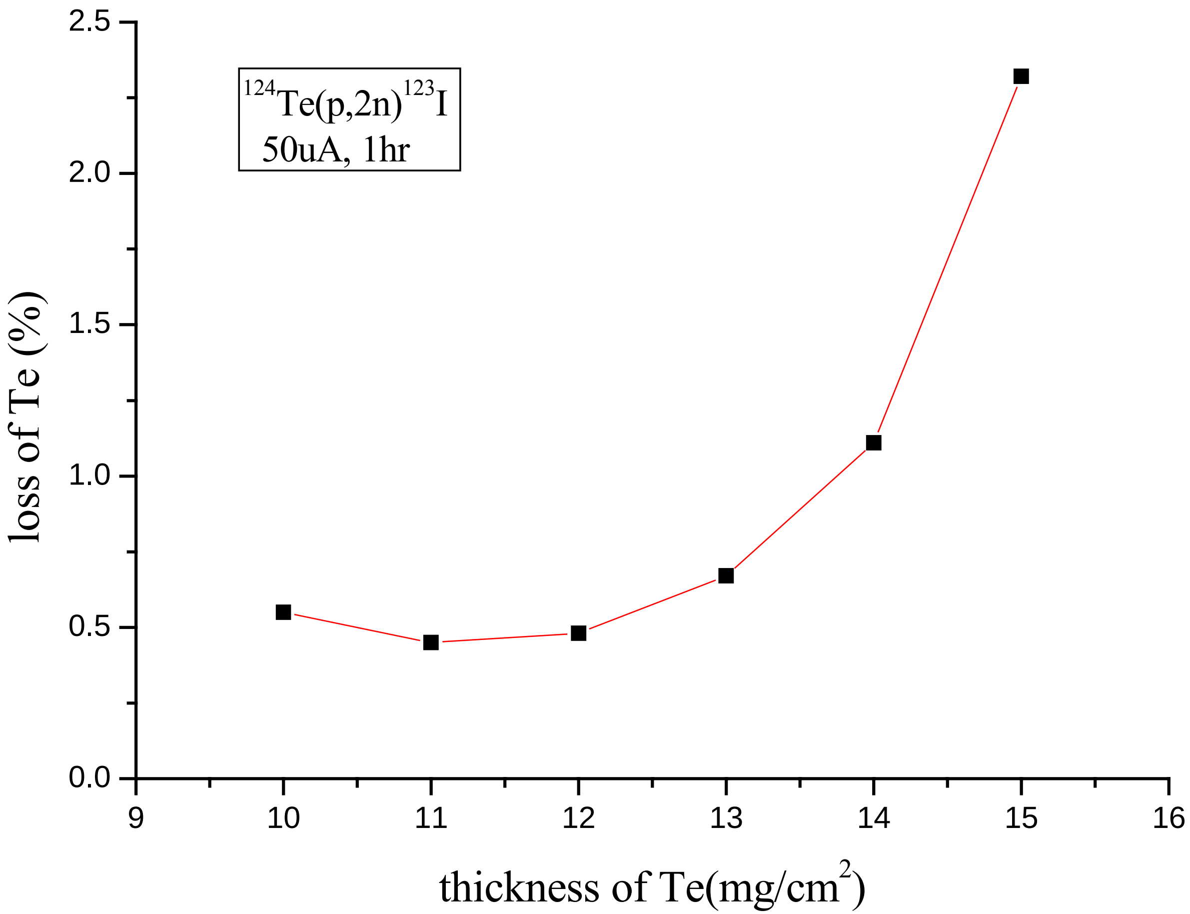


Fig.3 Relationship between loss of Te and thickness of Te

# Influence of thickness of Te on yield of $^{123}$I

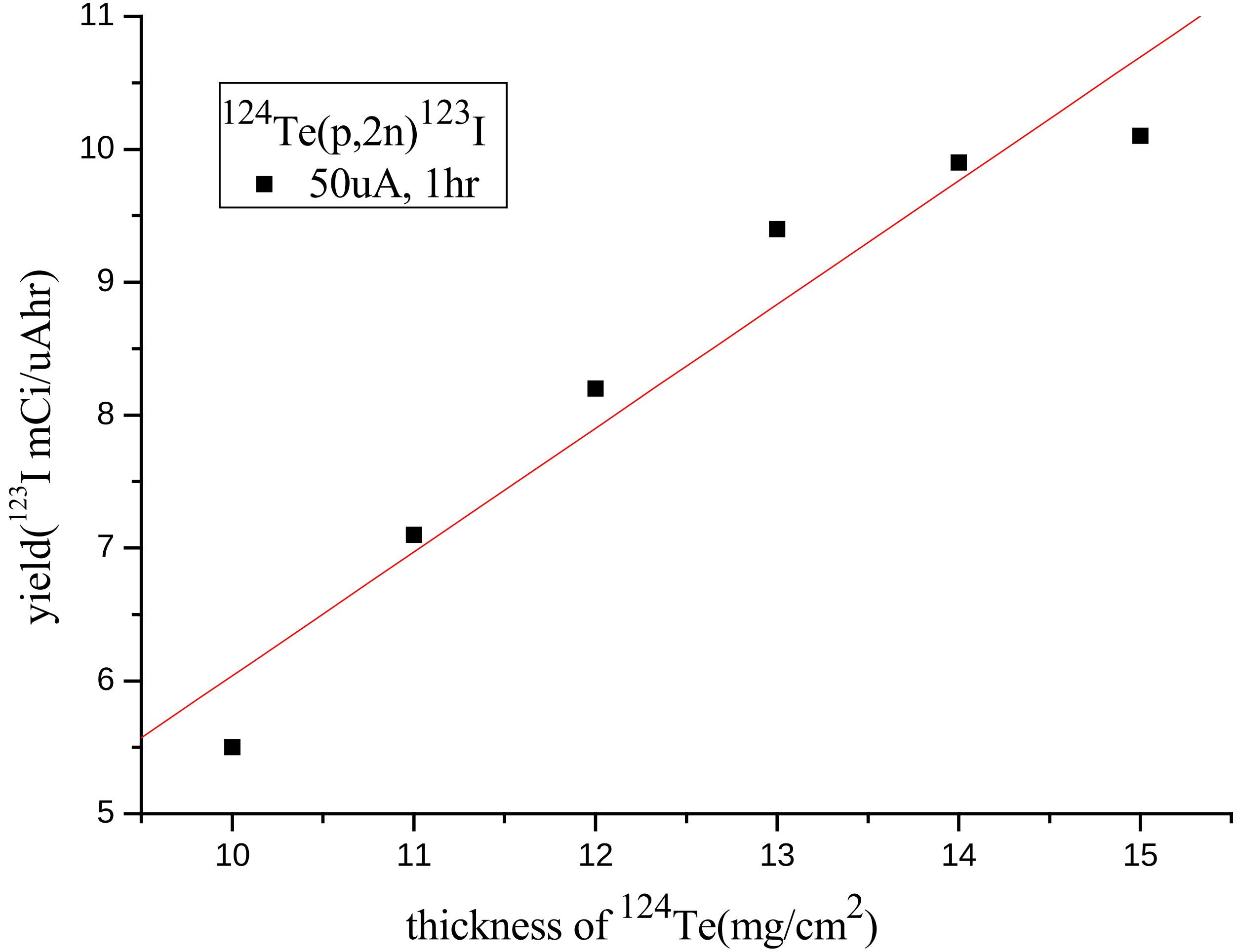


Fig.4 Influence of thickness of $^{124}$Te on yield of $^{123}$I

# Influence of integrated current on yield of $^{123}I$

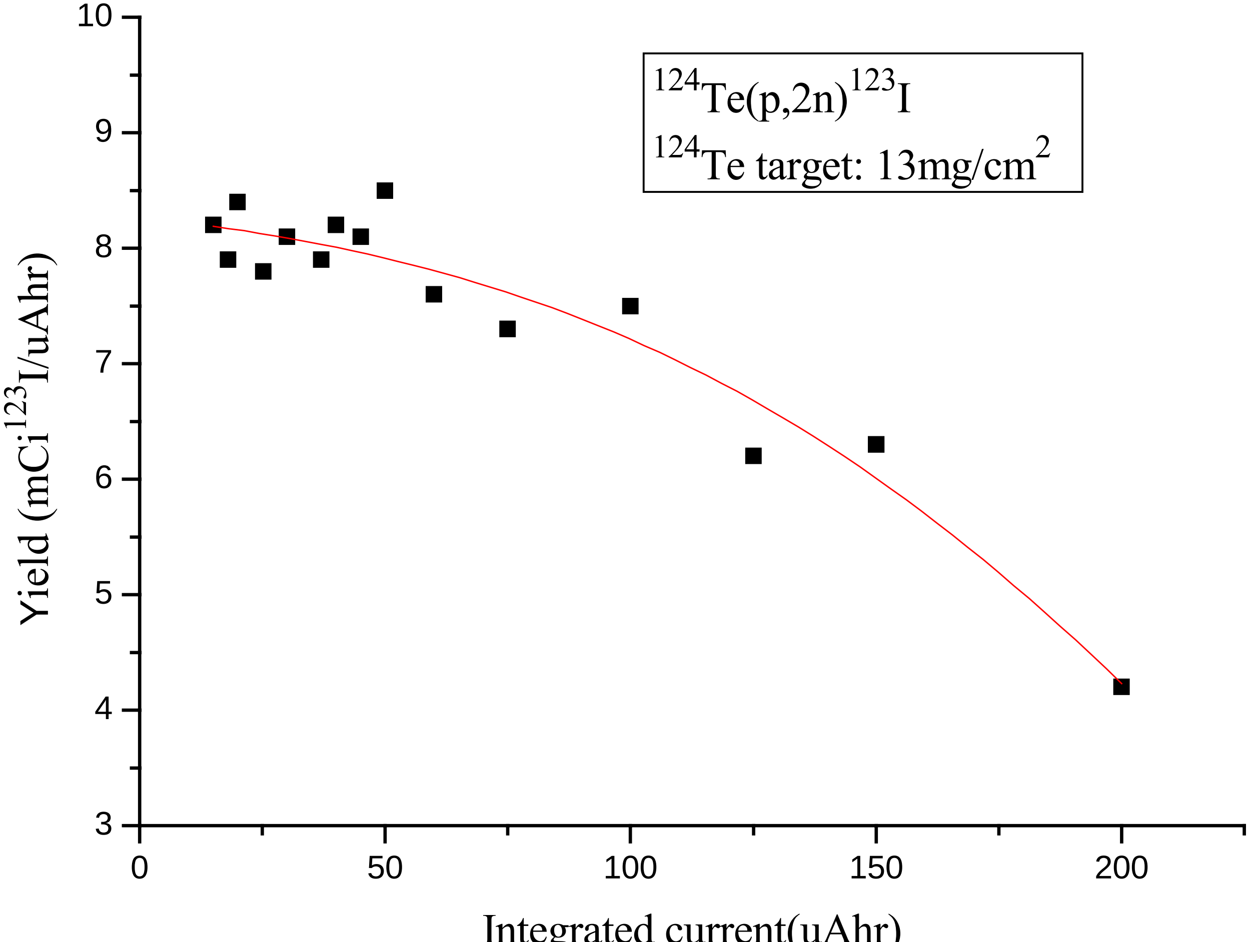


Fig.5 Relationship between yield of $^{123}I$ and integrated current

# Specification of $^{123}$I solution

- Radionuclidic purity: >98%.
- Radiochemical purity: Iodide $^{123}$I >95%
- Radioactivity concentration: >3700 MBq/mL.
- pH value: 7.5~9.0
- Concentration of Al: < 1ug/mL
- Concentration of Te: <1ug/mL
- Bacterial endotoxins: <30EU/mL

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# Thank you for your attention!