



Generation of proton and carbon ion beam from laser ion source using hydrocarbon oil target

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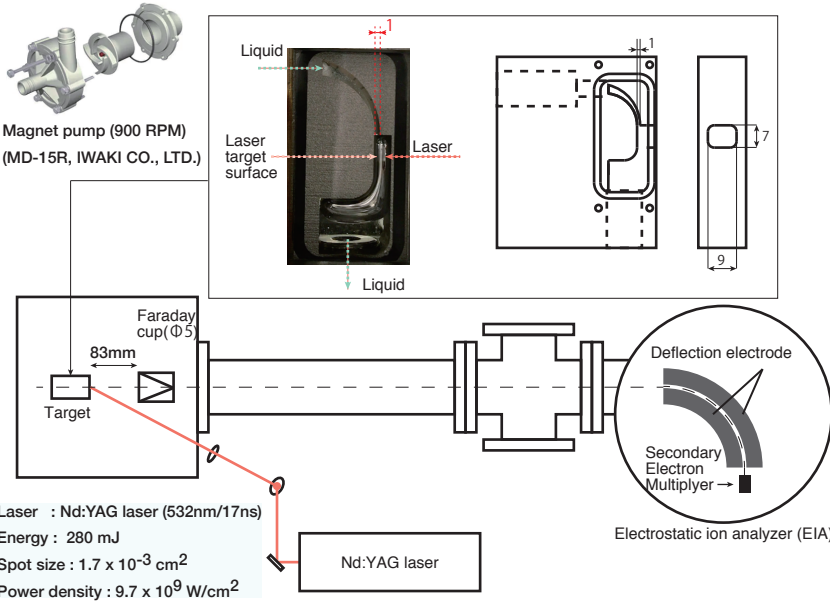
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Background and Motivation

The supply of high-flux proton and carbon ions are required for applications such as accelerator-driven neutron sources and heavy ion radiotherapy. So far, it is shown that a laser ion sources using the target of plastics made of hydrocarbons can provide protons and carbon ions. On the other hand, due to the damage of the target by laser irradiation, it is necessary to change the laser irradiation position every time, and the number of ion supply is limited to the area of the laser target. To solve the problem of target damage, we suggest a laser target in which the surface is continuously renewed by flowing hydrocarbon oil instead of solid hydrocarbon. In this study, we demonstrated the generation of protons and carbon ions using the target made of a hydrocarbon oil for a diffusion pump.

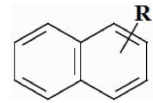
Experimental Setup



Target oil : Ulvoil D-11 (Diffusion pump oil)



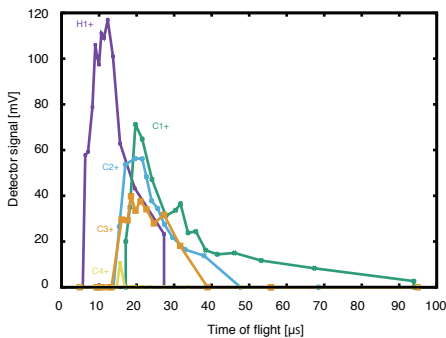
Alkyl naphthalene



合成油の種類	炭化水素系	Hydrocarbon
ULVOIL 型番号	D-11	(main component : alkyl naphthalene)
到達圧力 (Pa)	7×10^{-6}	Vapor pressure
蒸気圧 (20°C) (Pa)	7.3×10^{-5}	
蒸気圧 (40°C) (Pa)	1.7×10^{-3}	
蒸気圧 (100°C) (Pa)	1.5×10^{-1}	
比熱	$0.5 (100^\circ\text{C J/g})$	Average molecular weight
蒸発潜熱 (J/kg)	7.1×10^4	
平均分子量	366	
密度 (25°C g/cm ³)	0.91	Density
動粘度 (mm ² /s)	32	Viscosity
(測定温度 °C)	(40)	
酸値 (mg KOH/g)	< 0.1	
引火点 (°C)	221	
流動点 (°C)	-25以下	
外観色 (25°C)	淡黄色透明	
特長	汎用油	
ULVAC ゴンプ・シリーズ型式	PFL、F、ULK	
容器 (L)	18 1.0	

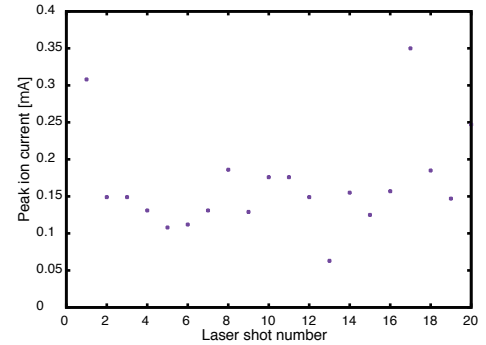
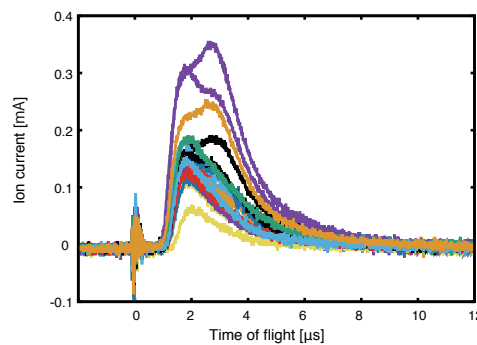
Experimental Results

Ion charge-state distribution



- Demonstrate the ion source of hydrocarbon oil targets by detecting protons and carbon ions

Reproducibility of ion current waveform



- The variation of ion current may be due to the fluctuation of flow surface.
- Splashes of oil were observed every laser shot. This phenomena reduces the circulating oil.

Summary

The results indicated that

- Forming a target of flowing hydrocarbon oil.
- Demonstrated ion current consisting of protons and carbon ions from laser ion source using the liquid target.
- The peak of the ion current waveform varied with laser irradiations which may be caused by fluctuation on liquid target surface.