## §7. Determination of the Response Function for a Particle Recycling System and its Application to Steady State Operation using Perturbation Methods

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A new approach to study the dynamics of particle recycling in steady state plasma has been proposed based on responses to externally controlled perturbations and demonstrated in QUEST [1]. According to measurements of the permeation flux and helium partial pressure in H plasma the retention and release processes are examined in addition to global gas balance [2]. By modulating the plasma-wall interaction PWI area the radial profile of the release rate is identified and the direct relation between the retention and ion fluxes is obtained by scanning probes. In this report a new technique for decision of the stimulated wall release process will be discussed.

In the gas balance equation we have to consider each contribution from many PWI regions, $\sum_i A^i\left(q_{rel}{}^i(t) - q_{ret}{}^i(t)\right)$, for example, i=0 the center stack(CS), i=1 top/bottom TB-plates , i=2 the outer sider walls, etc.. However, it is hardly to identify each contribution. So far in JET the temperature rise on the divertor strike zones was considered to correspond to the He release mechanism. On the contrary, in the present gas change-over (He->$H_2$) experiment using ECR plasma $q_{rel}$ for H and He particles from TB-plates was obtained by using the perturbation method. In rf low power $T_{wall}$ was not changed. Namely local value of $q_{rel}$ responding to the perturbation of PWI region on TB plates was decided without the temperature effect. In this experiment, the first discharge (#24236) was He plasma, and then gas was changed to $H_2$ in six sequential discharges. An annular slab ECR plasma was formed near the resonance region corresponding to 2.45GHz ECW and its PWI region on TB plates could be modulated sinusoidally from $R_{min}$(0.34m) to $R_{max}$ (0.88m) at the frequency $f_{PWI}$ = 100 mHz by modulating $B_t$. The half width ($\delta R$) of the PWI region is ~ 0.1 m decided from the ion saturation current $I_s$ profile of Langmuir probe array LPA. The 89 % area of the plates was swept as $A_w{}^1(t) = 2\pi\delta R\left(R_m + \Delta \sin(2\pi f_{PWI} t)\right) + A_{w0}{}^1$ ,where $R_m = \left(R_{min} + R_{max}\right)/2$ , $\Delta = \left(R_{max} - R_{min}\right)/2$ and $A_{w0}{}^1$ was the unperturbed area of the plate. According to the following relation,

$$2\left(\frac{d\tilde{P}_{H2}(t)}{dt} + \frac{\tilde{P}_{H2}(t)}{\tau_{H2-pump}}\right)\frac{V_{chamber}}{T_{wall}} \approx q_{rel}{}^{H} \qquad (1)$$

the hydrogen release rate $q_{rel}$ was decided in #24236, as shown in Fig. 1(a).

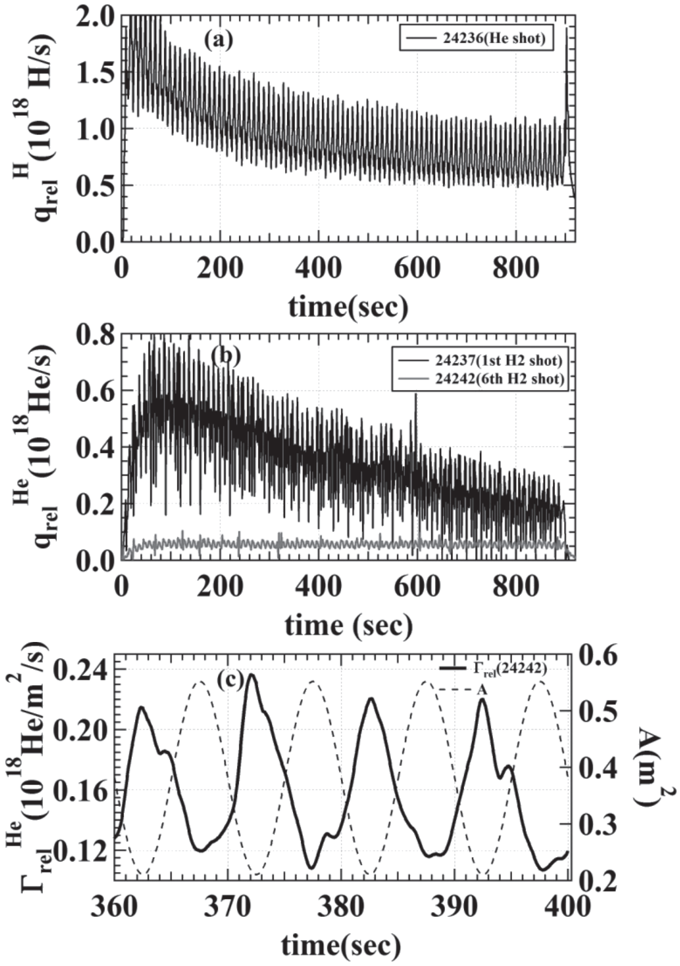


Fig.1 Release rates of H and He in the He to H2 gas changeover experiments. (a) $q_{\mathrm{rel}}$ for H in He plasma, (b) $q_{\mathrm{rel}}$ for He in the sequential H discharges(1st and 6th). (c) The PWI region $A^1$is scanned from 0.2 $m^2$to 0.55 $m^2$at $f_{\mathrm{PWI}}$=100 mHz. The He release flux correlates inversely well with $A^1$(t)

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