First *H*-mode with lower-hybrid current drive and lithium-wall coatings on the EAST superconducting tokamak

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In the recent experimental campaign of the Experimental Advanced Superconducting Tokamak (EAST) the first *H*-mode with type-III edge localized modes (ELMs) at an *H* factor of $H_{ITER89\text{-}P} \sim 1.7$ was produced by lower-hybrid wave (LHW) as only additional power source with strongly off-axis power deposition as required in Advanced Tokamak scenarios at a power level close to the threshold power (~1 MW) predicted by the international tokamak scaling. To access *H*-mode at this power level intensive lithium-wall coating was used. Before the application of lithium (Li) the *H*-mode was inaccessible. The threshold power for *H*-mode access follows the international tokamak scaling and a threshold in electron density was identified. This is good news for ITER since ITER will operate at very marginal power level at the beginning of its operation. EAST *H*-mode results demonstrated that the LHW is a promising inexpensive heating alternative for *H*-mode access at low threshold power, provided with steady state capability and compatible with Advanced Tokamak scenarios.

Strong accumulating effects of Li deposition on the *H*-mode access and performance have been observed. With increasing accumulating Li deposition the *H*-mode duration was gradually extended up to 6.4 s corresponding to 60 confinement times, limited only by the possible discharge duration at present. Finally, it was observed that the neutral density near the lower X-point was progressively reduced by a factor of 4 with increasing Li accumulated amount, which was considered as the main mechanism for the *H*-mode power threshold reduction by the Li-wall coatings. The application of lithium could therefore provide a relatively inexpensive way to enhance the performance of tokamak *H*-mode discharges or facilitate the *H*-mode access including ITER.