Supplementary Material

Ballistic transport in sub-10 nm monolayer InAs transistors for high-performance applications

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Table S1. Summary of ballistic transport performance of optimized n/p-type ML $InAsH_2$ MOSFETs with sub-10 nm gate length against ITRS 2013 requirements for HP device when n-MOSFETs are under the doping concentration of $1.5\times10^{13}cm^{-2}$, and p-MOSFETs are under the doping concentration of 6.0×10^{13} cm^{-2}.

	L_g (nm)	EOT (nm)	V_{dd} (V)	UL (nm)	SS (mV/dec)	I_{off} ($\mu A/\mu m$)	I_{on} ($\mu A/\mu m$)	I_{on}/I_{off}	τ(ps)	PDP (fJ/μm)
n-type	4.0	0.41	0.64	0	261	0.1	—	—	—	—
				1	200.7		—	—	—	—
				2	176.2		26.5	2.6×10^2	81.7	0.046
				3	140		847.7	8.5×10^3	0.249	0.045
				4	132.7		1064.9	1.1×10^4	0.328	0.097
	5.0	0.41	0.64	0	185.8	0.1	7.1	71	36.3	0.055
				1	162.4		107.5	1.1×10^3	2.554	0.059
				2	134.9		1230	1.2×10^4	0.247	0.065
				3	123.2		1327.5	1.3×10^4	0.205	0.056
				4	107.7		1741.8	1.7×10^4	0.126	0.053
p-type	4.0	0.41	0.64	0	367	0.1				
				1	252		—	—	—	—
				2	205.4					
				3	155.6		268.5	2.6×10^3	1.060	0.061
				4	143		445	4.4×10^3	0.504	0.030
	5.0	0.41	0.64	0	241	0.1	—	—	—	—
				1	194		17.7	1.7×10^2	12.15	0.046
				2	146		502	5.0×10^3	0.968	0.103
				3	129		862	8.6×10^3	0.426	0.078
				4	110		1011	1.0×10^4	0.345	0.074
ITRS HP 2028	5.1	0.41	0.64	—	—	0.1	900	—	0.423	0.243
n	7.5	0.49	0.69		112	0.1	2405.5	2.4×10^4	0.237	0.131
p	7.5	0.49	0.69	—	121	0.1	1124.4	1.1×10^4	0.457	0.118
ITRS HP 2024	7.3	0.49	0.68		—	0.1	1170	—	0.451	0.364
n	8.8	0.54	0.72		86.1	0.1	2660	2.6×10^4	0.264	0.168
p	8.8	0.54	0.72	—	100	0.1	2158	2.1×10^4	0.456	0.236
ITRS HP 2022	8.8	0.54	0.72		—	0.1	1330	—	0.463	0.45
n	10.1	0.56	0.74		75.9	0.1	2783	2.7×10^4	0.330	0.221
p	10.1	0.56	0.74	—	73.1	0.1	2619	2.6×10^4	0.343	0.229
ITRS HP 2022	10.1	0.56	0.74		—	0.1	1450	—	0.477	0.51

Table S2. Subthreshold swing *SS* and on-state current I_{on} of the *n*- and *p*-type DG ML $InAsH_2$ MOSFETs with the gate length L_g = 5 nm and *UL* = 2 nm under different doping concentrations against ITRS HP 2028 requirements.

L_g (nm)	UL (nm)		doping (cm^{-2})	*SS* (mV/dec)	I_{on} (μA/μm)
5	2	n-type	9×10^{12}	144	902
			1.5×10^{13}	135	1230
			2.4×10^{13}	130	762
		p-type	4.5×10^{13}	141	492
			6.0×10^{13}	146	502
			7.5×10^{13}	156	274
ITRS HP 2028	-				900

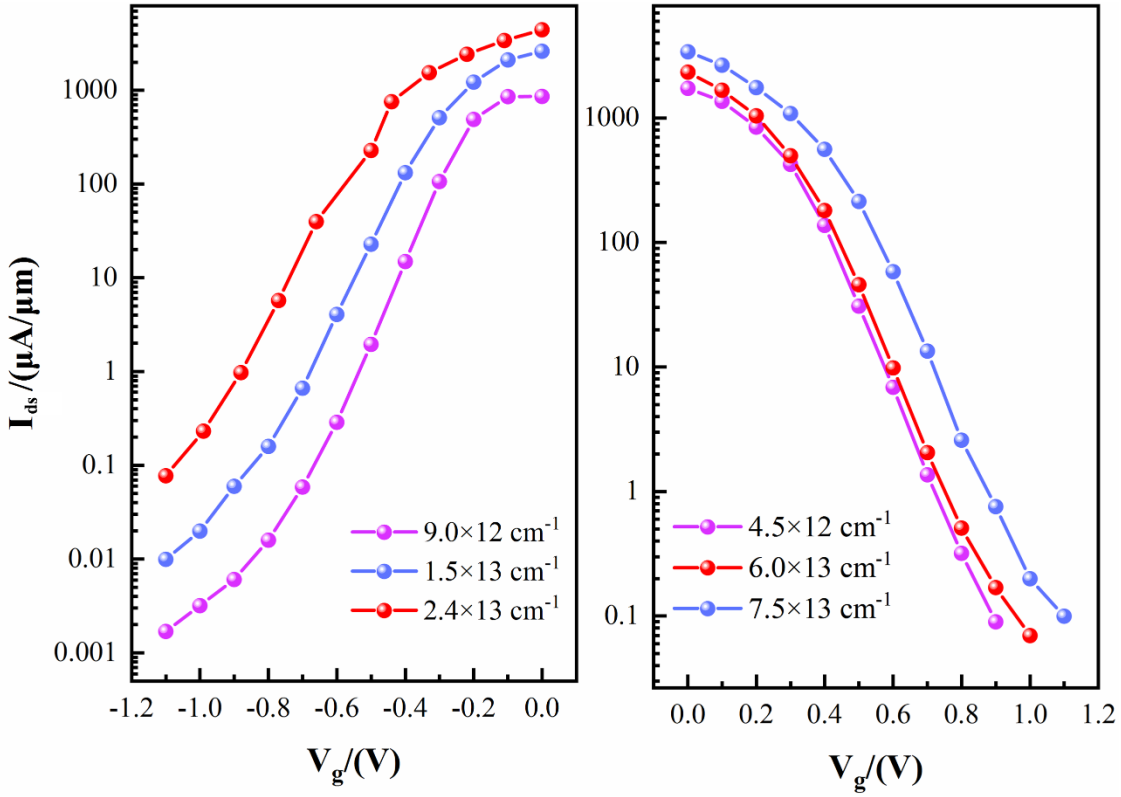

Figure S1. *I*-V_g characteristics of the *n*- and *p*-type DG ML $InAsH_2$ MOSFETs with L_g = 5 nmand *UL* = 2 nm with different electrode doping concentrations.

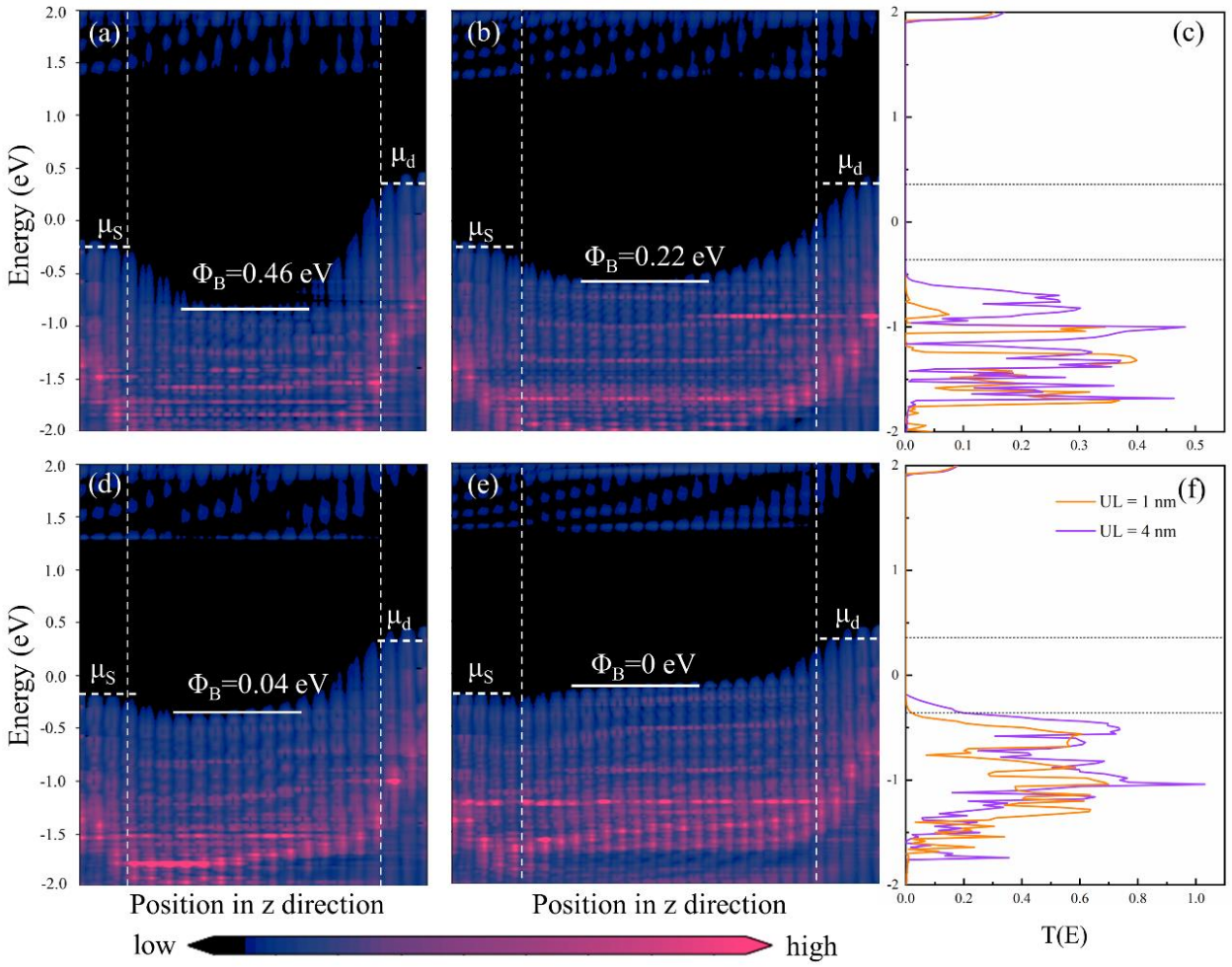

Figure S2. PLDOS and transmission spectra of p-type ML $InAsH_2$ MOSFETs with 5.0 nm-L_g at (a-c) off state and (d-e) on state.

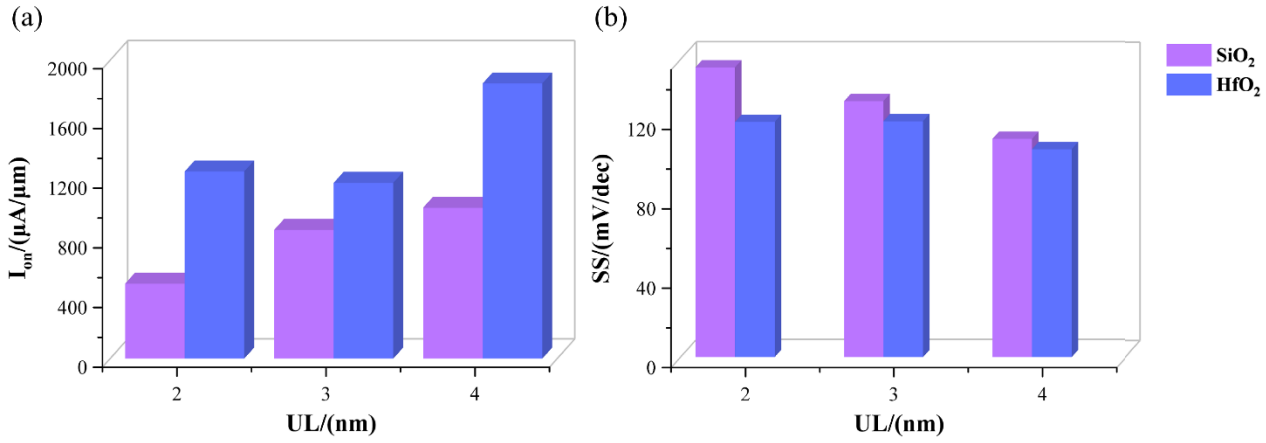

Figure S3. I_{on} (a) and SS (b) of p-ML $InAsH_2$ MOSFETs with different ULs and dielectric layers.

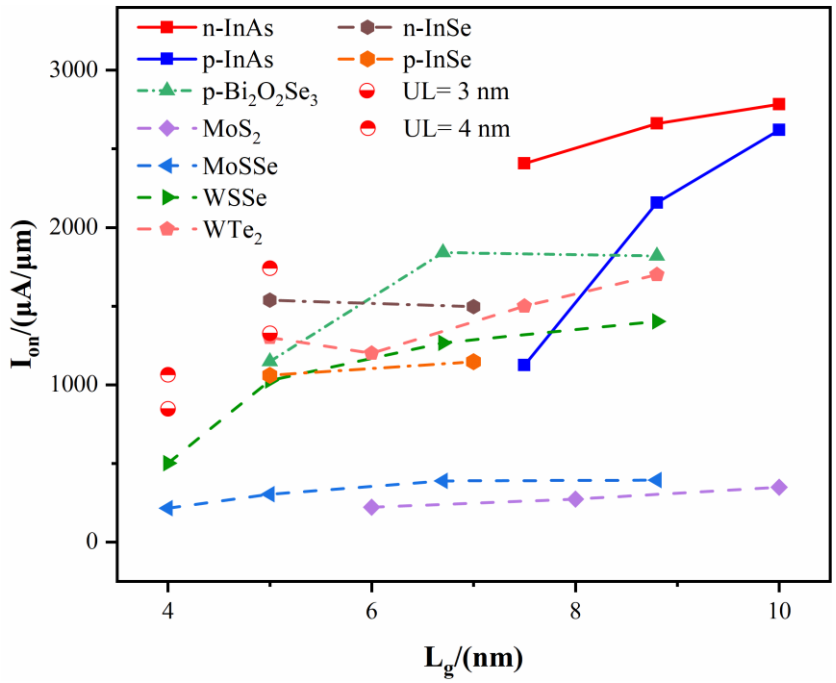

Figure S4. Comparison of I_{on} for n- and p-type ML $InAsH_2$(this work), p-type $Bi_2O_2Se_3$, MoS_2, MoSSe, WSSe, InSe, WTe_2, $MoTe_2$ MOSFETs in ITRS HP applications.