

SUPPLEMENTARY INFORMATION

Molecular Interactions of Antibody Drugs Targeting PD-1, PD-L1, and CTLA-4 in Immuno-oncology

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Supplementary Table S1. Residues involved in the interactions between PD-1 and anti-PD-1.

PD-1	Pembrolizumab	Nivolumab
S27		H _{Y53}
P28		H _{Y53} , H _{W52} , H _{G33}
D29		H _{N99} , H _{N31}
R30		H _{N31}
P31		H _{Y53}
S60		H _{N31} , H _{T28}
E61		H _{T28} , H _{G26}
S62	L _{Y57}	
V64	H _{M105}	
Y68	H _{Y101} , H _{R102}	
Q75	H _{T30}	
T76	H _{Y101}	
D77	H _{T30} , H _{S54}	
K78	H _{N52} , H _{Y33} , H _{D108}	
A81	H _{M105}	
F82	H _{F103} , L _{S32}	
P83	H _{F103} , L _{Y34}	
E84	L _{Y36}	
D85	H _{R99}	
R86	L _{S95} , L _{L100}	
S87	H _{R99} , H _{N59} , H _{Y35} , L _{L100}	
Q88	H _{Y35} , H _{Y33}	
P89	H _{Y35}	
G90	H _{T58} , H _{Y35} , H _{T58}	
L128	H _{Y34} , H _{F103} , H _{M105} , L _{Y57}	H _{G26}
A129	H _{M105}	H _{I27} , H _{Y102} , L _{T56}
P130		L _{A55} , L _{L46}
K131	H _{M105}	H _{N99} , L _{S91} , L _{Y49}
A132	H _{R102}	L _{Y49} , H _{I27}
Q133		H _{T28}
I134	H _{R102}	

The antibody residues, which make hydrogen bonding or salt bridge with PD-1, are colored red.

Supplementary Table S2. Residues involved in the interactions between PD-L1 and anti-PD-L1.

PD-L1	Atezolizumab	Durvalumab	Avelumab	BMS-936559
A18	hP102			
T20		L94, L95		
V23		L30		
D26		R28		
E45	S30			
D49	Y93			G105, Y32, hS104
A51	Y93			S106, L92
A52	L92, Y93			P107, hK99
I54	hW33, hW50		hS54, hG55	hI52, hF108
Y56	hW33, hW50, hS57	hS56	hY52, hP53, hS54, hI57	hH59, hF55
E58	hS52, hS57	hK52	hI33, hY52, hV104	hK57
M59			LY34	
E60	hY54, hT74	hW102	LY32, Y34, LY93	
D61	hG55, hT74	hW102	R99, hV104, hT105, hT106	
N63	hS57		G102, hT103	
Q66	hT58		hS31, hP53	hH59
V68	hW50, hY59			hH59, LW94
H69	hY59, LH94		hS54	hS106, LN93
D73			hS31	
K75			hF27, h728, hS31	
V76			G102	
V111	Y54	LY33, hF103, hE105		
R113	D31	hE57	hY52, hF53, L97	hF55
M115	hW33, hW50, hW101	hY59	hY52, hI57	hF55
S117	hW33		hG55, hI57	hI52
Y118	L31, L92			
G119	LA32, LY91, hR99			hY32
G120				hY32, hT31
A121	hW33, hW101	hY59	hI57	hT31
D122		L95		hI54
Y123	hW101, hD31	L95, LW97, hE99, hF103	hF53	hI54
K124		L94		
R125	hS30, hD31	L31, LY92, LG93, hF103	L95, L97	
T127		hW33		

The antibody residues, which make hydrogen bonding or salt bridge with PD-L1, are colored red.

Supplementary Table S3. Residues involved in the interactions between CTLA-4 and anti-CTLA-4.

CTLA-4	Ipilimumab	Tremelimumab
K1	LQ27	LN30, LS28
A2		LQ27, LY92,
M3	LY33	LN30
E33	HN57	HN57
R35	HY53	HY53
L39	HW101, HL102	HA103
Q41		HY107, HY105
S44	LY50	HL105
V46	HW101, HL102	HT104
E48	HW101, HS31	HY53
L91		HY107, HT104
I93		HY107, HG102
K95	HW101, HY53	HG102
E97	HT33, HY53	HR105, HY59
M99	HS52, HY53, HN57, HY59	HY59
Y100	HN57, HY59	
P101	HY59	
P102	HY59	HY59
P103	LS95	LT94
Y104	HF50, HY59, LS94, LS95, LW97	HY59
Y105	LG93, LS94	LY92
L106	HL102, HG103, LY33, LY92, LG93	HY106, HY110, HR105
I108	HW101, HL102, LY33	HY110
N110		HY107, HY108, HY110

The antibody residues, which make hydrogen bonding or salt bridge with CTLA-4, are colored red.