Supplemental Data Set1. The results of deep amplicon sequencing of Cas9 system

Targets	Reads	inserts	Deletions	Editing efficiency
MAPDSt1_KO	50589	1	3	0.01%
MAPDSt1_WT	16752	1	3	0.02%
MAPDSt2_KO	83480	2	4	0.01%
MAPDSt2_WT	29223	0	12	0.04%
MAPDSt3_KO	115558	36	5	0.04%
MAPDSt3_WT	28757	0	10	0.03%
MAPDSt4_KO	119303	444	337	0.65%
MAPDSt4_WT	85985	2	4	0.01%
MAPDSt5_KO	22	0	0	0.00%
MAPDSt5_WT	14	1	0	7.14%
MAPDSt6_KO	80384	0	147	0.18%
MAPDSt6_WT	32119	0	4	0.01%
MAPDSt7_KO	120862	127	539	0.55%
MAPDSt7_WT	55854	1	16	0.03%
MAPDSt8_KO	107568	320	800	1.04%
MAPDSt8_WT	38919	0	5	0.01%
MAPDSt9_KO	76852	204	115	0.42%
MAPDSt9_WT	14379	0	1	0.01%

Supplemental Data Set2. The results of deep amplicon sequencing of Cas12a system

Targets	Reads	inserts	Deletions	Editing efficiency
MACPF1_t1	44984	1	81	0.18%
MACPF1t1_WT	16428	11	1	0.07%
MACPF1_t2	21878	1	15	0.07%
MACPF1t2_WT	8813	0	2	0.02%
MACPF1_t3	26805	0	25	0.09%
MACPF1t3_WT	8850	0	1	0.01%
MACPF1_t4	216728	1	18	0.01%
MACPF1t4_WT	130179	1	7	0.01%
MACPF1_t5	0	0	0	0.00%
MACPF1t5_WT	0	0	0	0.00%
MACPF1_t6	62	43	9	83.87%
MACPF1t6_WT	18	16	0	88.89%
MACPF1_t7	52965	3	75	0.15%
MACPF1t7_WT	26512	0	1	0.00%
MACPF1_t8	56866	1	52	0.09%
MACPF1t8_WT	26399	0	2	0.01%
MACPF1_t9	29008	0	114	0.39%
MACPF1t9_WT	36703	1	1	0.01%
MACPF1_t10	27728	1	87	0.32%
MACPF1t10_WT	36885	0	3	0.01%
MACPF1_t11	23931	2	0	0.01%
MACPF1t11_WT	36909	1	1	0.01%

Supplemental Data Set3. The results of deep amplicon sequencing of RNP system

Targets	Reads	inserts	Deletions	Editing efficiency
MARNPPDS_t1	81613	45	36	0.10%
MARNPPDSt1_WT	76687	0	11	0.01%
MARNPPDS_t2	110993	395	267	0.60%
MARNPPDSt2_WT	116895	0	6	0.01%
MARNPPDS_t3	226711	70	30	0.04%
MARNPPDSt3_WT	162757	0	14	0.01%
MARNPPDS_t4	288822	343	442	0.27%
MARNPPDSt4_WT	186542	0	6	0.00%
MARNPPDS_t5	16	0	0	0.00%
MARNPPDSt5_WT	13	0	0	0.00%
MARNPPDS_t6	138085	169	1104	0.92%
MARNPPDSt6_WT	141210	0	22	0.02%
MARNPPDS_t7	211619	591	305	0.42%
MARNPPDSt7_WT	183742	0	14	0.01%
MARNPPDS_t8	196805	23	110	0.07%
MARNPPDSt8_WT	165821	0	10	0.01%
MARNPPDS_t9	102866	166	26	0.19%
MARNPPDSt9_WT	119080	0	3	0.00%

Supplemental Data Set4. Primer pairs of off tatget detection

Name	Primer_F	Primer_R
MA21680	TTCCCCTCTCCTATACGGTGTCGCCCTG	TGCTGAATCATTTATCTGCCTTCTTTC
ngsMA21680-1	CGATGTAAGCGGAAAACAGAGCCGAG	TGACCAGGGCCGACCAATACAGCACC
ngsMA21680-2	ACAGTGAAGCGGAAAACAGAGCCGAG	GCCAATGGGCCGACCAATACAGCACC
ngsMA21680-3	CAGATCAAGCGGAAAACAGAGCCGAG	CTTGTAGGGCCGACCAATACAGCACC
ngsMA21680-4	ATCACGAAGCGGAAAACAGAGCCGAG	TTAGGCGGGCCGACCAATACAGCACC
ngsMA21680-5	ACTTGAAAGCGGAAAACAGAGCCGAG	GATCAGGGGCCGACCAATACAGCACC
ngsMA21680-6	TAGCTTAAGCGGAAAACAGAGCCGAG	GGCTACGGGCCGACCAATACAGCACC
ngsMA21680-7	AGTCAAAAGCGGAAAACAGAGCCGAG	AGTTCCGGGCCGACCAATACAGCACC
ngsMA21680-8	ATGTCAAAGCGGAAAACAGAGCCGAG	CCGTCCGGGCCGACCAATACAGCACC
ngsMA21680-9	GTAGAGAAGCGGAAAACAGAGCCGAG	GTCCGCGGGCCGACCAATACAGCACC
ngsMA21680-wt	GTGAAAAAGCGGAAAACAGAGCCGAG	GTGGCCGGGCCGACCAATACAGCACC

Supplemental Data Set5. The results of off-target of Cas9 system

Targets	Reads	inserts	Deletions	Editing efficiency
MAOFFTARGET_1	124266	1	2	0.00%
MAOFFTARGET_2	133552	3	2	0.00%
MAOFFTARGET_3	119751	0	4	0.00%
MAOFFTARGET_4	102579	0	3	0.00%
MAOFFTARGET_5	140420	0	10	0.01%
MAOFFTARGET_6	123859	0	2	0.00%
MAOFFTARGET_7	122724	0	2	0.00%
MAOFFTARGET_8	120746	0	3	0.00%
MAOFFTARGET_9	134415	1	0	0.00%
MAOFFTARGET_WT	119352	1	3	0.00%

Supplemental Data Set6. The results of off-target of RNP system

Targets	Reads	inserts	Deletions	Editing efficiency
MAOFFTARGET_1	206250	1	6	0.00%
MAOFFTARGET_2	283105	1	17	0.01%
MAOFFTARGET_3	253061	0	6	0.00%
MAOFFTARGET_4	205521	0	7	0.00%
MAOFFTARGET_5	236819	0	10	0.00%
MAOFFTARGET_6	226224	1	10	0.00%
MAOFFTARGET_7	257234	0	9	0.00%
MAOFFTARGET_8	230694	0	7	0.00%
MAOFFTARGET_9	211818	1	8	0.00%
MAOFFTARGET_WT	283419	1	2	0.00%

Supplemental Data Set7. Primer pairs used in construct OsU3p-PDS

OsU3p-PDS	gRNA (24 bp)（Primer_F）	gRNA (24 bp)（Primer_R）
MAPDSt1	ggcgGGCTCCAATTTGGTTGCTTA	aaacTAAGCAACCAAATTGGAGCC
MAPDSt2	ggcgTTTTCTGCAAAGACTTCCCG	aaacCGGGAAGTCTTTGCAGAAAA
MAPDSt3	ggcgCATCTTTCTGCAATGGTCCA	aaacTGGACCATTGCAGAAAGATG
MAPDSt4	ggcgACTTCATCATTGACTCGGTC	aaacGACCGAGTCAATGATGAAGT
MAPDSt5	ggcgCATGAGATCCATTGTTCTGC	aaacGCAGAACAATGGATCTCATG
MAPDSt6	ggcgCAAGCTTATGTGGAGGCGC	aaacGCGCCTCCACATAAGCTTG
MAPDSt7	ggcgATAAGCTTGCCCTCCAAGCA	aaacTGCTTGGAGGGCAAGCTTAT
MAPDSt8	ggcgTTGTCCTTAAGCAACCAAAT	aaacATTTGGTTGCTTAAGGACAA
MAPDSt9	ggcgAGACATGTCCGTCACATGCA	aaacTGCATGTGACGGACATGTCT

Supplemental Data Set8. Primer pairs used in Construct Cas12a-PDS

Cas12a	gRNA (27 bp)（Primer_F）	gRNA (27 bp)（Primer_R）
MACPFPDSt1	agatGATGCCACCAGTATCTTCTCTGA	ggccTCAGAGAAGATACTGGTGGCATC
MACPFPDSt2	agatACAAATGTTCTGGAAGCAACAAA	ggccTTTGTTGCTTCCAGAACATTTGT
MACPFPDSt3	agatAAAATGAAGGCTCCAATTTGGTT	ggccAACCAAATTGGAGCCTTCATTTT
MACPFPDSt4	agatTGCAATGGTCCACGGCCAAGAAA	ggccTTTCTTGGCCGTGGACCATTGCA
MACPFPDSt5	agatCACCCAGGACATCTCTAGCCTCC	ggccGGAGGCTAGAGATGTCCTGGGTG
MACPFPDSt6	agatGGGAACTTGGTATCAATGATCGC	ggccGCGATCATTGATACCAAGTTCCC
MACPFPDSt7	agatGCAGATTCGATTTCCCAGAAACT	ggccAGTTTCTGGGAAATCGAATCTGC
MACPFPDSt8	agatCCAGAAACTCTTCCTGCACCTTT	ggccAAAGGTGCAGGAAGAGTTTCTGG
MACPFPDSt9	agatCAATATTAAGAAATAGTGAAATG	ggccCATTTCACTATTTCTTAATATTG
MACPFPDSt10	agatTCTGGCCAAGTCAGCATTTCACT	ggccAGTGAAATGCTGACTTGGCCAGA
MACPFPDSt11	agatCACTTGGACTTTTGCCAGCCATG	ggccCATGGCTGGCAAAAGTCCAAGTG

Supplemental Data Set9. Primer pairs used in vitro transcription of sgRNA

sgRNA	PCR primer(vitro transcription template)
vtr-MAPDSt1F	TTAATACGACTCACTATAGGCTCCAATTTGGTTGCTTAgttttag
vtr-MAPDSt2F	TTAATACGACTCACTATAGGTTTTCTGCAAAGACTTCCCGgttttag
vtr-MAPDSt3F	TTAATACGACTCACTATAGGCATCTTTCTGCAATGGTCCAgttttag
vtr-MAPDSt4F	TTAATACGACTCACTATAGGaCTTCATCATTGACTCGGTCgttttag
vtr-MAPDSt5F	TTAATACGACTCACTATAGGCATGAGATCCATTGTTCTGCgttttag
vtr-MAPDSt6F	TTAATACGACTCACTATAGGCAAGCTTATGTGGAGGCGCgttttag
vtr-MAPDSt7F	TTAATACGACTCACTATAGGATAAGCTTGCCCTCCAAGCAgttttag
vtr-MAPDSt8F	TTAATACGACTCACTATAGgTTGTCCTTAAGCAACCAAATgttttag
vtr-MAPDSt9F	TTAATACGACTCACTATAGGAGACATGTCCGTCACATGCAgttttag
vtr-MAsgRg2R	AAGCACCGACTCGGTGCCACT

Supplemental Data Set10. Primer pairs used in capture-sequencing of Cas9 and RNP system

OsU3p-PDS	Primer_F	Primer_R
MAPDS1t1-3,8	TAAGAATATAGAGGCCAGCATGAACATTATCGG	TCACTCCATATACATGTTGGCATCTTTAGCA
MAPDS1t4	ATATAAACATGTCATTTCGTGTCAACCAGT	TTTGTGCATTTTGTTCGATATGAATATGGACT
MAPDS1t5	CAGTGGAAACTTCTTTCTGAGTATTTTGAGAGG	TTCACATATATTGGTTTGATAGCTCACCGTA
MAPDS1t6-7	CAAGCCAGGAGAGTTTAGCAGATTCGATTTCC	CCCGTTCAAACTTATCAACATTAAAGCACAAGACCATAG
MAPDS1t9	AGAACACCTATGACCATCTTCTATTCAGC	GTTGAATTGGATCCCACAGGAGCACACT
ngsMAPDSt1	ACTTGAGATACTGGTGGCATCCAAATCCTGA	TGACCAAAGCTTGGCAATACAGAAAAACTAAAGGAG
ngsMAPDSt2	ACTTGATGATTTATCACCGGGAAATAGTGGA	TGACCACTAAAGATATCAGAATGTCATACCTGCAC
ngsMAPDSt3	ATCACGTGATTTATCACCGGGAAATAGTGGA	GATCAGCTAAAGATATCAGAATGTCATACCTGCAC
ngsMAPDSt4	ACTTGACTTTGCTAAGTTAATATGTTCTTTGATAAGTG	TGACCAAAAACGGTTCAAAGCAATTAATACACA
ngsMAPDSt5	ACTTGAATCACCAGCTTAATAGGAAATTTTTCTAGAAC	TGACCATCTCATCAGGAAATAGCTTAGCCAGT
ngsMAPDSt6	ACTTGATGCAATATTAAGAAATAGTGAAATGCTGA	TGACCATCAAATTGAAAAAGATGGCTATATTTCGG
ngsMAPDSt7	ATCACGTGCAATATTAAGAAATAGTGAAATGCTGA	GATCAGTCAAATTGAAAAAGATGGCTATATTTCGG
ngsMAPDSt8	ATCACGGATACTGGTGGCATCCAAATCCTGA	GATCAGAAGCTTGGCAATACAGAAAAACTAAAGGAG
ngsMAPDSt9	ACTTGAGTGTTCCACATTGTTTCCTTCCAG	TGACCACAAAATTAAGAGTCAACAAACTAAGGTG
ngsMAPDSwt1	ACAGTGGATACTGGTGGCATCCAAATCCTGA	CAGATCAAGCTTGGCAATACAGAAAAACTAAAGGAG
ngsMAPDSwt2	ACAGTGTGATTTATCACCGGGAAATAGTGGA	CAGATCCTAAAGATATCAGAATGTCATACCTGCAC
ngsMAPDSwt3	ATGTCATGATTTATCACCGGGAAATAGTGGA	GTAGAGCTAAAGATATCAGAATGTCATACCTGCAC
ngsMAPDSwt4	ACAGTGCTTTGCTAAGTTAATATGTTCTTTGATAAGTG	CAGATCAAAACGGTTCAAAGCAATTAATACACA
ngsMAPDSwt5	ACAGTGATCACCAGCTTAATAGGAAATTTTTCTAGAAC	CAGATCTCTCATCAGGAAATAGCTTAGCCAGT
ngsMAPDSwt6	ACAGTGTGCAATATTAAGAAATAGTGAAATGCTGA	CAGATCTCAAATTGAAAAAGATGGCTATATTTCGG
ngsMAPDSwt7	ATGTCATGCAATATTAAGAAATAGTGAAATGCTGA	GTAGAGTCAAATTGAAAAAGATGGCTATATTTCGG
ngsMAPDSwt8	ATGTCAGATACTGGTGGCATCCAAATCCTGA	GTAGAGAAGCTTGGCAATACAGAAAAACTAAAGGAG
ngsMAPDSwt9	ACAGTGGTGTTCCACATTGTTTCCTTCCAG	CAGATCCAAAATTAAGAGTCAACAAACTAAGGTG

Supplemental Data Set11. Primer pairs used in capture-sequencing of Cas12a system

Cas12a	Primer_F	Primer_R
MACPF1PDS1-5	TGTTTCTTCTTTACATTCTACCCGTTGTTCC	GGCACATGTTTATGGATCATAGTACAAGTGG
MACPFPDS6-11	GAATGCCCATATATCTGGACAAATGCTT	GCAGTCATTTGAACTTTGATCTAAGCA
ngsMACPFPDSt1	CGATGTTCGATTGTAGATAGACCTGC	CGATGTCAGTTTGTTGCTTCCAGAAC
ngsMACPFPDSt2	CAGATCCATTATCGGATCTGTCTCTC	CTTGTATTTGAAACCCATGAACTCAC
ngsMACPFPDSt3	ACTTGAGTGGAACAATTCAGAGAAGA	GATCAGGAGAGGGCTGGCACCATGTC
ngsMACPFPDSt4	AGTCAATTCTGCAAAGACTTCCCGAG	AGTTCCGATATTCTCTGCATTTAGGT
ngsMACPFPDSt5	GTAGAGCTTCTGGTAGGTCTGGCTGG	GTAGAGCATATCATAGATTCAAAGCC
ngsMACPFPDSt6	GTTTCGGAAGTTGGGGCATATCCCAA	CGTACGTTCTGGGAAATCGAATCTGC
ngsMACPFPDSt7	ACTGATGGTATCAATGATCGCTTGCA	ATGAGCTCACATTCTAATTACACGAA
ngsMACPFPDSt8	CAACTAGGTATCAATGATCGCTTGCA	CACCGGTCACATTCTAATTACACGAA
ngsMACPFPDSt9	CAGGCGACTTCTGCAAATTAGTGGTG	CATGGCGCTTGCCCTCCAAGCATGGC
ngsMACPFPDSt10	CGGAATACTTCTGCAAATTAGTGGTG	CTAGCTGCTTGCCCTCCAAGCATGGC
ngsMACPFPDSt11	GCGCTAGAAATAGTGAAATGCTGACT	TAATCGAAGATGGCTATATTTCGGTA
ngsMACPFPDS1wt	ACAGTGTCGATTGTAGATAGACCTGC	GCCAATCAGTTTGTTGCTTCCAGAAC
ngsMACPFPDS2wt	ATCACGCATTATCGGATCTGTCTCTC	TTAGGCTTTGAAACCCATGAACTCAC
ngsMACPFPDS3wt	TAGCTTGTGGAACAATTCAGAGAAGA	GGCTACGAGAGGGCTGGCACCATGTC
ngsMACPFPDS4wt	ATGTCATTCTGCAAAGACTTCCCGAG	CCGTCCGATATTCTCTGCATTTAGGT
ngsMACPFPDS5wt	GTGAAACTTCTGGTAGGTCTGGCTGG	GTGGCCCATATCATAGATTCAAAGCC
ngsMACPFPDS6wt	GAGTGGGAAGTTGGGGCATATCCCAA	GGTAGCTTCTGGGAAATCGAATCTGC
ngsMACPFPDS7wt	ATTCCTGGTATCAATGATCGCTTGCA	CAAAAGTCACATTCTAATTACACGAA
ngsMACPFPDS8wt	CACGATGGTATCAATGATCGCTTGCA	CACTCATCACATTCTAATTACACGAA
ngsMACPFPDS9wt	CATTTTACTTCTGCAAATTAGTGGTG	CCAACAGCTTGCCCTCCAAGCATGGC
ngsMACPFPDS10wt	CTATACACTTCTGCAAATTAGTGGTG	CTCAGAGCTTGCCCTCCAAGCATGGC
ngsMACPFPDS11wt	TACAGCGAAATAGTGAAATGCTGACT	TATAATAAGATGGCTATATTTCGGTA