

Int. J. Mol. Sci. **2008**, 9, 1-12

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+67896:72;6:<"=;>96:<"? "
Molecular Sciences
ISSN 1422-0067

Keywords: d>:67>4" A;75!" ?<;@ " CF7; 4 879F!" ?<>;985C867" A878C72;6!" A878C72;6" <2427!" :>7;?<>;985C86C8/"

1. Introduction

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H26C8" Y28" *et al*" :6A" M<2L25:7;5 *et al*." B>O<25E8A" 7E8" ?2957" 98B;975" A85C92026P" 7E8" >58" ;?" d) 5" :5" ?<>;985C867" <:O8<5" ?;9" O2; 4 ;<8C><85" 26" -00" " f#!" &g!" 26789857" 26" 7E829" :BB<2C:72;65" E:5" 26C98:58A" 86;9 4 ;>5<F/" d) 5" :98" 98L;<>72;62526P" 4 :6F" 78CE62J>85" 26" O2;<;P2C:<" :6A" O2; 4 8A2C:<" :6:<F525" :6A" 7E829" >58" E:5" O886" 98B;978A" 26" 4 :6F" :BB<2C:72;65" 26C<>A26P" C8<<" 2 4 :P26P" f[!" \g!" 4 >72B<8e8A" :6:<F525" ;?" <2L26P" C8<<5" f\$!" cg!" 2 4 :P26P" ;?" 867298" 5>OC8<<<:9" 579>C7>985" f' g!" A878C72;6" :6A" 7:9P8726P" ;?" 5B8C2?2C" C8<<5" fOg!" 79: CX26P" C8<<5" ;L89"<;6P" B892;A5" ;?" 72 4 8" f- .g" :6A"<:O8<26P" 7255>85" :6A"<2L8" 4 2C9; ;9P:625 4 5" f--%-[g/" d) 5" :98" O826P">58A" C>99867<F" :5" : " 6;L8<" ?<>;9;BE;985" O8C:>58" 7E829" BEF52C:<" :6A" CE8 4 9 (2) 79 (C) 79 (:) 79 (<)

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5; <72; 6/"M"B; 972; 6"Rc. "moT" @ :5"79

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489C>9F"<: 4 B"?;9"09; :A%0:6A"8eC27:72;6/" aE8"?2<7895"58<8C78A"?;9" K j "8eC27:72;6"@898") I "[. .":6A"o%
[#."@E2CE"98?<8C7":<<"<PE7">6A89" [. ."64"O>7":<<@;"7E8"B:55:P8";?"@:L8<86P7E5"<;6P89"7E:6" [#."64/"
aE8"?2<789"587"58<8C78A"?;9"O<>8"<PE7"8eC27:72;6">72<258A"GS"[0.!) I "\. .":6A":5>BB<84867:9F"8eC2789"
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:O;L8" \ - \ "64/"H: 4 B<85"@898"A298C7<F" 4 ;>678A";67;"5<A85"OF" 42e26P" \ "mo";?"5: 4 B<8"@27E" \ "mo";?"
D272?<>;9"MV%&"RD272?<>;9" o7A!"K vT":6A"58:<26P"@27E

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RV2P>98" [] T/" M" A:7:" ?2<8" C;67:2626P"&!... "8L8675" @ :5"98C;9A8A" ?;9"8:CE"5: 4B<8" :6:<F`8A/" aE8" ?<>;985C86C8"26786527F" ;07:268A" ?9; 4"O;7E" o26X89V+aD%08:A"C; 4B<8e85" :6A" d)%08:A"C; 4B<8e85"@ :5" B<;778A" ;6" : "E257;P9: 4!"5E; @26P"7E:7"7E8" ?<>;985C867"26786527F" ;?" d)%08:A"C; 4B<8e85"@ :5"E2PE89"7E:6" V+aD" :7"7E8"5: 4 8"C;6C8679:72; 65"RV2P>98" [NT/"

Figure 4. V<; @ "CF7; 4 8792C" :6:<F525" ;?"08:A%?<>;9;BE;98" C; 4 B<8e85"/"M(" K6<:08<<8A"08:A5" ;6" : "A;7%B<;7" ;?"Vo- "Re% :e25T"L895>5"VHD"RF% :e25T"@898"B; 5272; 68A"@27E26"7E8" ?2957" A8C:A8" ;?" ?<>;985C86C8/"G,"K6<:08<<8A"08:A5" ;6" : "A;7%B<;7" ;?"Vo&"Re% :e25T"L895>5"VDH"RF% :e25T"@898" :<5;"B; 5272; 68A"@27E26"7E8" ?2957" A8C:A8/"D," o26X89V+aD%08:A"C; 4B<8e85" ;6" : "A;7%B<;7" ;?" Vo- "Re% :e25T"L895>5"VHD"Rk% :e25T" :7" : "C;6C8679:72;6" ;?" ./ \$"B 4 ;<" ;?" o26X89V+aD/") , " d) 5% 08:A" C; 4B<8e85" ;0589L8A" ;6" : " A;7%B<;7" ;?" Vo&" RF% :e25T" L895>5" VHD" RF% :e25T" :7" : " C;6C8679:72;6" ;?" ./ \$"B 4 ;<" ;?" d) 5"5E; @8A"26C98:58A"26786527285" ;L89"V+aD/"N,"M"E257;P9: 4" ;?"7E8" ?<>;985C867"26786527F" ?;9" d)%08:A5"RO<>8" <268T" :6A" o26X89V+aD%08:A5"RO<:CX" <268T" C; 4B<8e85" L895>5" >6<:08<<8A"08:A5" R98A" <268T" :7"7E8" 5: 4 8" ?<>;9;BE;98" C;6C8679:72;6" 26" 5;<>72;6"R./ \$"B 4 ;<T/

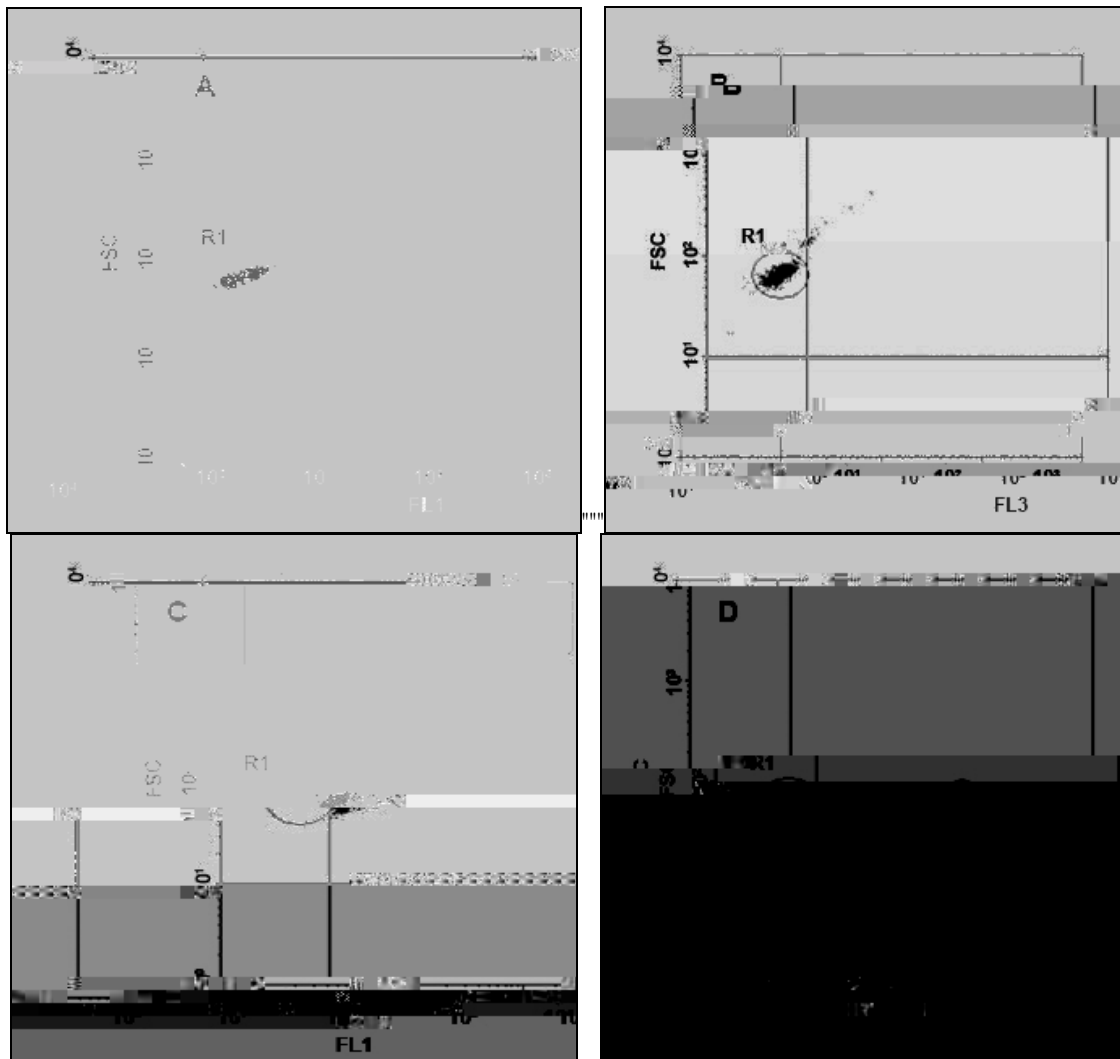
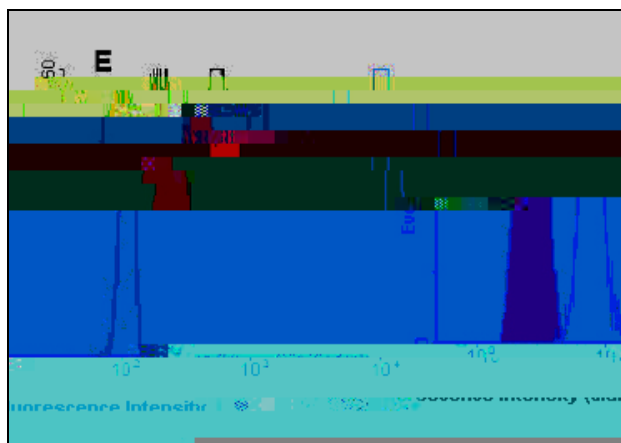


Figure 4. D; 67/



2.7. Data Analysis

Figure 4 shows the fluorescence intensity of the probe in the presence of the probe. The fluorescence intensity of the probe is significantly enhanced in the presence of the probe, indicating a strong binding between the probe and the probe. The fluorescence intensity of the probe is significantly enhanced in the presence of the probe, indicating a strong binding between the probe and the probe.

2.8. Characterization of Probe Binding to QDs

The fluorescence intensity of the probe is significantly enhanced in the presence of the probe, indicating a strong binding between the probe and the probe. The fluorescence intensity of the probe is significantly enhanced in the presence of the probe, indicating a strong binding between the probe and the probe.

The fluorescence intensity of the probe is significantly enhanced in the presence of the probe, indicating a strong binding between the probe and the probe. The fluorescence intensity of the probe is significantly enhanced in the presence of the probe, indicating a strong binding between the probe and the probe.

3. Results

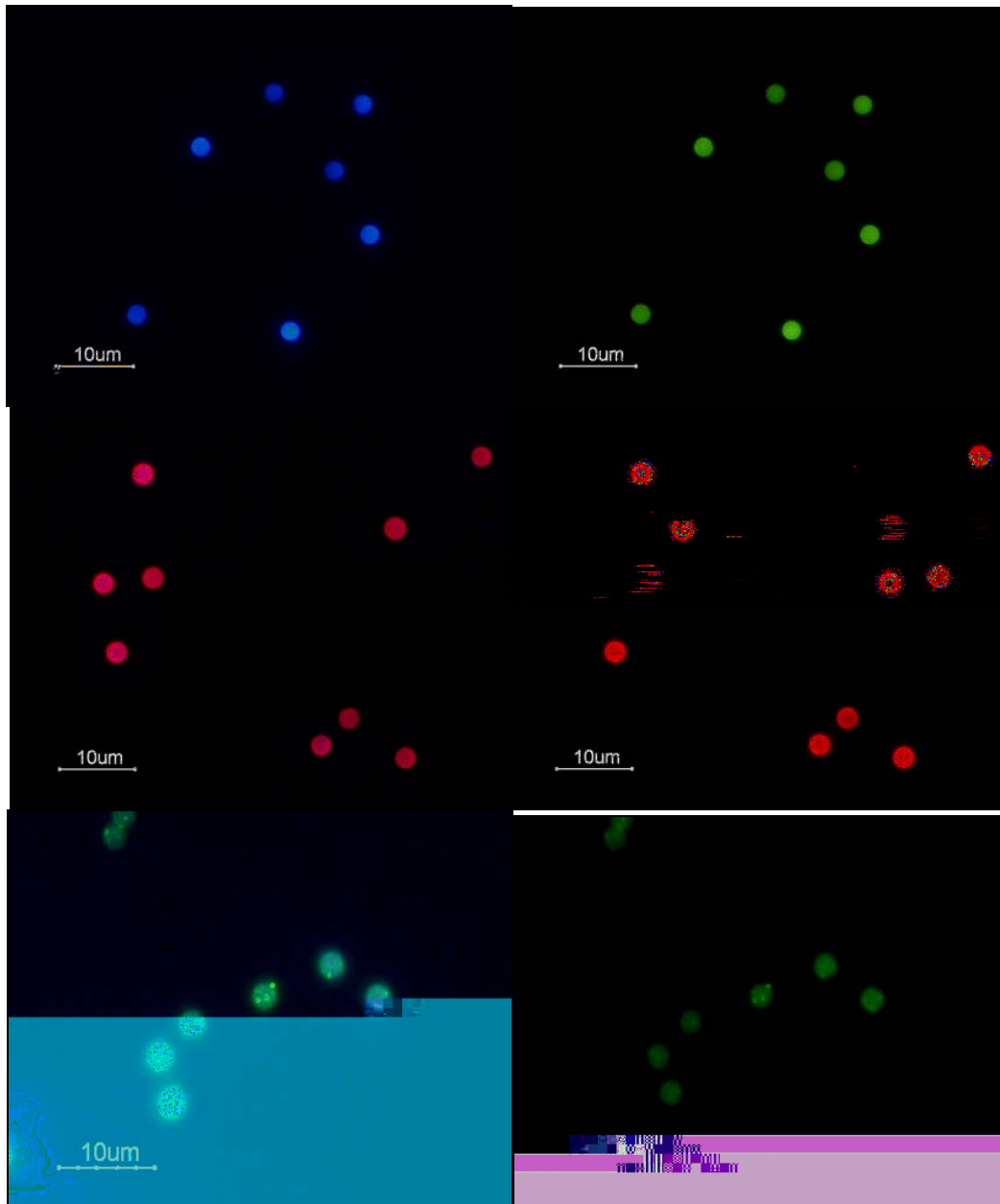
3.1. Excitation - Emission Spectra of QDs

$dA; 7^{a1} \$ \backslash \backslash " G2; 726" C; 63 > P: 785" @ 898" 8eC278A" 087 @ 886" \& - . " 64" 7; " [0. " 64" > 526P" : " < > 42685C86C8" 5B8C79; 48789/" aE8" 842552; 6" 5B8C79 > 4" @ : 5" A878C78A" 087 @ 886" \ . . " 64" 7; " c . . " 64/" aE8" d) 5" : 6 : < F` 8A" 8eE20278A" 4 : e24 > 4" ? < > ; 985C867" 842552; 6" : 7" \$ \ \ " 64" RV2P > 98" \ T/" aE8" 985 > < 75" 26A2C : 78A" 7E : 7" d) 5" 984 : 268A" ? < > ; 985C867" > 6A89" : < < " 7E8" 8eC27 : 72; 6" @ : L8 < 86P7E5" 8e : 4268A/" M" [% ? ; < A" 26C98 : 58" 26" ? < > ; 985C86C8" 26786527F" @ : 5" ; 0589L8A" : 7" 5E ; 97" 8eC27 : 72; 6" @ : L8 < 86P7E5" RK j " w" & # . " 64T" C ; 4B : 98A" @ 27E" 7E8" < ; 6P89" 8eC27 : 72; 6" @ : L8 < 86P7E" R [' " 64T" 7E : 7" 25"C ; 4 4 ; 6F" > 58A" 26" ? < ; @ " CF7 ; 487895/"$

Figure 5. NeC27:72;6" % " 842552;6" 5B8C79:" ; ?" 98A" d) 5/" Z% : e25, " ? < > ; 985C86C8" 26786527F" 26" : 90279:9F" > 6275/" s % : e25, " NeC27:72;6" @ : L8 < 86P7E5" R64T/" k % : e25, " N42552;6" @ : L8 < 86P7E5" R64T/" aE8" 842552;6" B8:X" @ : 5" ; 0589L8A" : 7" \$ \ \ " 64" ? ; 9" : < < " 8eC27 : 72; 6" @ : L8 < 86P7E5" 8e : 4268A/"

h ;B5%k8<< ;@ " d) 5" @ : 5" ; 0589L8A" > 6A89" K j " 8eC27:72 ; 6"RV2P>98"\$NT/" h ; @8L89!" h ;B5%k8<< ;@ " d) 5" @898" ? ; > 6A"7 ; " ? ; 9 4 "C > 57895" ; 6"7E8"5 > 9? : C8" ; ?"7E8") F6 : 08 : A5!" @E2CE"985 < 78A"26" : PP< ; 4 89 : 72 ; 6/"

Figure 6. " + 4 : P85" ; ?" > 6< : 08<<8A" 08 : A5" : 6A" d) %08 : A" C ; 4 B<8e85" ; 0589L8A" > 6A89" K j " : 6A" 0<>8" <2PE7" OF" 8B2%?<> ; 985C86C8" 4 2C9 ; 5C ; BF/" M, " K6< : 08<<8A" 08 : A5" > 6A89" K j " <2PE7/" G, " K6< : 08<<8A" 08 : A5" > 6A89" 0<>8" <2PE7/" D, " d) \$ \ \%08 : A" C ; 4 B<8e85" > 6A89" K j " <2PE7" 8eE202726P" : " 092PE7" 98A" ?<> ; 985C86C8/") , " d) \$ \ \%08 : A" C ; 4 B<8e85" > 6A89" 0<>8" <2PE7" : <5 ; " 8eE2027" : " 5E2?7" 7 ; " 98A" ?<> ; 985C86C8/" N, " h ; B5%k8<< ; @ " d) %08 : A" C ; 4 B<8e85" > 6A89" K j " <2PE7" 8eE20278A" P9886" ?<> ; 985C86C8" : 6A" C > 57895" ; ?" F8<< ; @ " ?<> ; 985C86C8" A > 8" 7 ; " : PP< ; 4 89 : 72 ; 6" ; ?" 7E8" d) 5" V, " h ; B5%k8<< ; @ " d) %08 : A" C ; 4 B<8e85" > 6A89" 0<>8" <2PE7" : <5 ; " 8eE2027" P9886" : 6A" F8<< ; @ " ?<> ; 985C86C8/"



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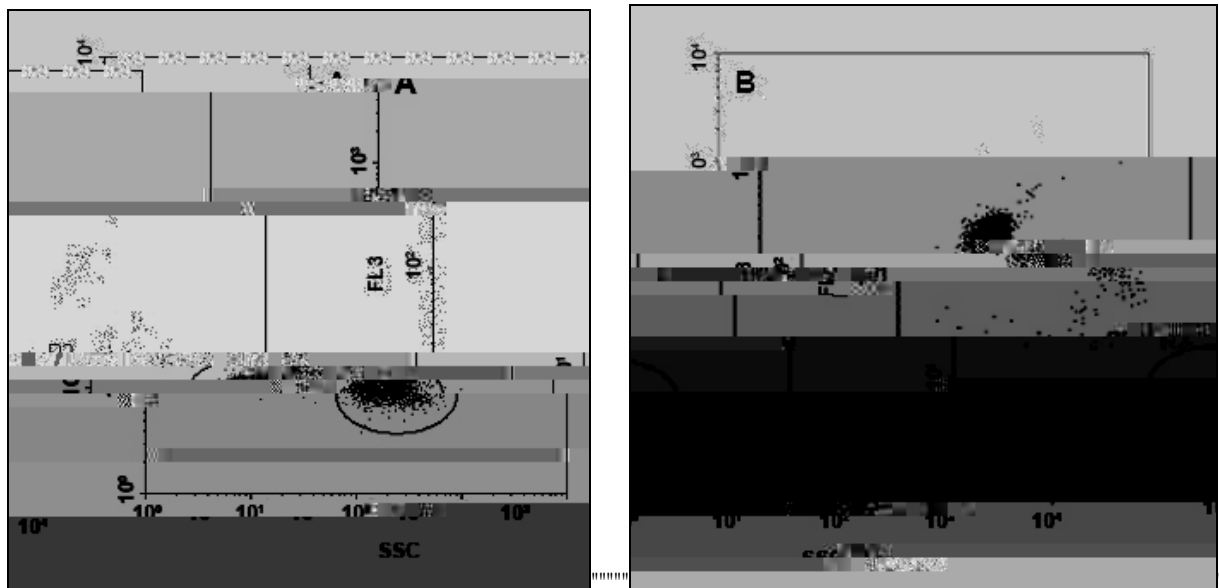
3.3. Qualitative Demonstration of the Binding of QDs to Dynabeads

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aE8" ?<>;985C867" 52P6:<5" ;?") F6:08:A5" <:08<<8A" @27E" 0;7E" ?<>;9;BE;985" RV+aD" :6A" d) \$\\T" @898" :6:<F` 8A"OF" ?<;@CF7; 4 879F" :6A"7E8" I V+"L:<>85"C;<<8C78A"RV2P>98"OT/" aE8" I V+"L:<>8" ;?"8:CE"5: 4 B<8" @:5" ;07:268A"OF" A8?2626P" :6"8<2B72C:<"98P2;6" :9;>6A"7E8"C86798" ;?"7E8" 4 :26" ?<>;985C26P" B;B><;72;6" ;?") F6:08:A5" Rq#T/" * 6C8" 7E8" 98P2;6" @:5" A8?268A!" 7E8" I V+" L:<>8" @:5" ;07:268A" >526P" 7E8" D8<<d>857" 5;?7@:98/" aE8" 4 :e24>4" O26A26P" C:B:C27F" ;?" O8:A5" ?;9" ;<2P;6>C<8;72A85" B9;085!" :5" 26A2C:78A" OF" 7E8" B9;A>C7" A:7:"5E887!" @:5" #. . "B 4 ;<;?" O2;726F<:78A" B9;08" B89" \ "mo" ;?") F6:08:A5" 57;CX"5 ;<72;6/" h ;@8L89!" 7E8" O26A26P" C:B:C27F" ;?") F6:08:A5" :BB8:98A"7;" O8" A2?89867" ?;9" 7E8" 7@ ;" ?<>;9;BE;985" 8e: 4 268A/"

Figure 8. V<;@CF7; 4 8792C" :6:<F525" ;?" d) \$\\ " 0;>6A" 7;") F6:08:A5/" G2L:92:78" A;7%B<;75" A8?2626P" <;P" Vo&" CE:668<" RF%:e25T" L895>5" <;P" HHD" CE:668<" Re%:e25T" M(" K6<:08<<8A") F6:08:A5/" M" C29C><:9" 98P2;6" Rq#T" @:5" A8?268A" :9;>6A" 7E8" >6<:08<<8A") F6:08:A5/" G(" d) \$\\ " 0;>6A" 7;") F6:08:A5/" M" 52P6?2C:67" 26C98:58" 26" ?<>;985C86C8" 8 4 2552;6" OF" 7E8" C; 4 B<8e"C;6?29 4 8A"5>CC855?><"O26A26P" ;?" d) \$\\ "7;" 7E8") F6:08:A5/"



) F6:08:A5" <:08<<8A" @27E" d) \$\\ "@898";0589L8A"7;"98:CE" 4 :e24>4" O26A26P" C:B:C27F" :7" 52P6?2C:67<F" <;@89" C;6C8679:72;65" 7E:6" V+aD" RV2P>98" OT/" aE8" ?<>;985C867" 52P6:<" ;?" d) \$\\ " 0;>6A" 7;") F6:08:A5" 26C98:58A" 8eB;68672:<<F" >672<" 7E8F" 98:CE8A" 7E829" 5:7>9:72;6" B;267" R./#" B 4 ;<T/" h ;@8L89!" o26X89V+aD" 0;>6A" 7;" 7E8" O8:A5" C;6?29 4 8A" 7E8" 57:78A" O8:A" C; 4 4 89C2:<" O26A26P" C:B:C27F" :5" 7E8" 4 :e24>4" ?<>;985C867" 26786527F" @:5" ;0589L8A" :7" - . "B 4 ;<;?" o26X89V+aD" B89" \ "mo" ;?" O8:A5" RV2P>98" OT/" aE8" I V+" L:<>8" ;?"8:CE"98:C72;6" 5E;@8A" 7E:7" d) \$\\ " 0;>6A" 7;") F6:08:A5" C;>A" O8" C<8:9F" A25C92 4 26:78A" :0;L8" 7E8" 68P:72L8" C;679;<" :7" : 4 ;>675" d) 5" :5" <;@:5" /. - "B 4 ;<" GF" C; 4 B:925;6!" 7E8" 4 2624>4" : 4 ;>67" 98J>298A"7;" A878C7" C<8:9F" o26X89V+aD" 0;>6A" 7;") F6:08:A5" :0;L8" 7E8" 68P:72L8" C;679;<" @:5" :7" : 4 >CE" E2PE89" C;6C8679:72;6" ;?" - "B 4 ;<" aE>5!" 7E8" d) \$\\ "%0

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2679:98A" ?>;985C867" 7FB8" ++" J>:67>4 " A;75" ?;9" 5867268<" <F4 BE" 6;A8" 4 :BB26P/" *Nat. Biotechnol.* **2004**!"22!"0&%0c/"

0/"] >!" s/("o2>!" h/("o2>!"=/(("h :<8F!" v/Y/("a98:A@:F!"=M/("o:95;6!"=S/("U8!"Y/("S8:<8!"V/("G9>CE8`!" I/" +4 4>6;?>;985C867"<:08<26P";?"C:6C89" 4 :9X89" h 89#":6A";7E89"C8<<<:9"7:9P875"@27E"58 4 2C;6A>C7;9" J>:67>4 "A;75/"*Nat. Biotechnol.* **2003**!"21!" [-%["\$/"

-./" h;5E26;!"M/("h:6:X2!" v/("H>`>X2!" v/("k: 4: 4;7;!" v/"MBB<2C:72;65";?" a%F4 BE; 4 : "<:08<8A" @27E" ?>;985C867" J>:67>4 " A;75" 7;" C8<<" 79:C26P" 4 :9X895" 26" 4 ;>58" 0;AF/" *Bioch. Biophys. Res. Comm.* **2004**!"314!"[\$%\&/"

--/" MX894 :6!" I /N/("DE:6!"] /D/] /("o::XX;686!"S/("GE:72:!"H/Y/("q>;5<:E72!"N/"Y:6;C9F57:<5"7:9P8726P" *in vivo*/"*Proc. Natl. Acad. Sci. USA* **2002**!"99!"-#\$-c%-#\$#-/"

-#/" U:;! " s/("D>2!" k/("o8L865;6!" q/ I /("DE>6P!"o/] /v/("Y28!"H/"*In vivo*"C:6C89"7:9P8726P":6A"24 :P26P" @27E"58 4 2C;6A>C7;9"J>:67>4 "A;75/"*Nat. Biotechnol.* **2004**!"22!"0\$0%0c\$/"

-&/" v<;8B?89!"=M/(" I 28<X8!"q/N/("] ;6P!" I /H/("Y8:<

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#\/" DE:77;B:AEF:F!" S/v/(" S92C8!")/M/(" h:9B89!" a/V/(" G8775!" I/q/(" k>!" =/(" U;572CX!" N/(" S89?877;!" H/S/(" U;8B?897!" S/(" v;>B!" q/M/(")8" q;5:!" H/D/(" G9>CE8`!" I/S/(" q;8A8989!" I/" d>:67>4" A;7" 5842C;6A>C7;9" 6:6;C9F57:<5" ?;9" 24 4>6;BE86;7FB26P" OF" B;<FCE9; 4 :72C" ?<;@ " CF7; 4 879F" *Nature Medicine* **2006!** I2!"Oc#%0cc/"

#\$/ " NAP:9!" q/(" I Cv26579F!" I /(" h@:6P!" =/(" *BB86E824!" M/G/(" V8X878!" q/M/(" U2><2:6!" U/(" I 8992<!" D/(" Y:P:5E24 :!" v/(" MAEF:!" H" h2PE%5865272L27F" O:C7892:<" A878C72;6" >526P" O2;726%7:PP8A" BE:P8" :6A" J>:67>4%A;7" 6:6;C; 4B<8e85/" *Proc. Natl. Acad. Sci. USA* **2006, 103!** [' [-% [' [\.

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#' /" oF;65!"M/G/("S:925E!"D/q/(") 8789 4 26:72;6" ;?"<F 4 BE;CF78" A2L252;6"OF" ?<;@ "CF7; 4 879F/" *J. Immunol. Methods* **1994!**171!"-&-%-&c/"

#0/" j 8:<!")/M/(") 8898!")/(" V899:92!" G/(" S2B289!" =/(" M77?28<A!" S/ j /" V<>;985C86C8" 57:2626P" :6A" ?<;@ " CF7; 4 879F" ?;9" 4 ;627;926P" 4 2C9;02:<"C8<<5/" *J. Immunol. Methods* **2000!**243!"-0-%#- ./"

&./" a;672!")/(" I ;>92X!"V/("DE89P>2!" I /" *6"7E8"8eC27:72;6"@ :L8<86P7E"A8B86A86C8";?"7E8"<>4 2685C86C8" F28<A";?"C;<<2A"DAH8"J>:67>4" A;75/" *Nano. Lett.* **2004!**4!"#[' &##[' c/"

&-/"] >!" k/("D: 4B;5!"H/v/(" o;B8`!"U/S/(" * `O>6!" I/M/("HX<:9!" o/M/("G>9:6A:!" a/" aE8"A8L8<;B 4 867" ;?" J>:67>4" A;7" C:<209:72;6" O8:A5" :6A" J>:6727:72L8" 4 ><72C;<;9" O2;:55:F5" 26" ?<;@ " CF7; 4 879F" :6A"

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