

Anti-DNA-RNA Hybrid [S9.6] Antibody – Publications (Updated June 2018)

Original:

1. Boguslawski SJ, Smith DE, Michalak MA, Mickelson KE, Yehle CO, Patterson WL, Carrico RJ. Characterization of monoclonal antibody to DNA:RNA and its application to immunodetection of hybrids. *J Immunol Methods*. 1986 May 1;89(1):123-30.
2. Phillips DD, Garboczi DN, Singh K, Hu Z, Leppla SH, Leysath CE. The sub-nanomolar binding of DNA:RNA hybrids by the single-chain Fv fragment of antibody S9.6. *J Mol Recognit*. 2013 Aug;26(8):376-81.
3. Hu Z, Zhang A, Storz G, Gottesman S, Leppla SH. An antibody-based microarray assay for small RNA detection. *Nucleic Acids Res*. 2006 Apr 13;34(7):e52.

Chip/Chip-seq:

1. El Hage A, French SL, Beyer AL, Tollervey D. Loss of Topoisomerase I leads to R-loop-mediated transcriptional blocks during ribosomal RNA synthesis. *Genes Dev*. 2010 Jul 15;24(14):1546-58.
2. El Hage A, Webb S, Kerr A, Tollervey D. Genome-Wide Distribution of RNA:DNA Hybrids Identifies RNase H Targets in tRNA Genes, Retrotransposons and Mitochondria. *PLoS Genet*. 2014 Oct 30;10(10):e1004716.
3. Lima WF, Murray HM, Damle SS, Hart CE, Hung G, De Hoyos CL, Liang XH, Croke ST. Viable RNaseH1 knockout mice show RNaseH1 is essential for R loop processing, mitochondrial and liver function. *Nucleic Acids Res*. 2016 Jun 20;44(11):5299-312.
4. Watanabe T, Marotta M, Suzuki R, Diede SJ, Tapscott SJ, Niida A, Chen X, Mouakkad L, Kondratova A, Giuliano AE, Orsulic S, Tanaka H. Impediment of Replication Forks by Long Non-coding RNA Provokes Chromosomal Rearrangements by Error-Prone Restart. *Cell Rep*. 2017 Nov 21;21(8):2223-2235.

Immunofluorescence:

1. Bhatia V, Barroso SI, García-Rubio ML, Tumini E, Herrera-Moyano E, Aguilera A. BRCA2 prevents R-loop accumulation and associates with TREX-2 mRNA export factor PCID2. *Nature*. 2014 Jul 17;511(7509):362-5.
2. Rigby RE, Webb LM, Mackenzie KJ, Li Y, Leitch A, Reijns MA, Lundie RJ, Revuelta A, Davidson DJ, Diebold S, Modis Y, Macdonald AS, Jackson AP. RNA:DNA hybrids are a novel molecular pattern sensed by TLR9. *EMBO J*. 2014 Mar 18;33(6):542-58.
3. Starokadomskyy P, Gemelli T, Rios JJ, Xing C, Wang RC, Li H, Pokatayev V, Dozmorov I, Khan S, Miyata N, Fraile G, Raj P, Xu Z, Xu Z, Ma L, Lin Z, Wang H, Yang Y, Ben-Amitai D, Orenstein N, Mussaffi H, Baselga E, Tadini G, Grunebaum E, Sarajlija A, Krzewski K, Wakeland EK, Yan N, de la Morena MT, Zinn AR, Burstein E. DNA polymerase- δ regulates the activation of type I interferons through cytosolic RNA:DNA synthesis. *Nat Immunol*. 2016 Mar 28.
4. Aronica L, Kasperek T, Ruchman D, Marquez Y, Cipak L, Cipakova I, Anrather D, Mikolaskova B, Radtke M, Sarkar S, Pai CC, Blaikley E, Walker C, Shen KF, Schroeder R, Barta A, Forsburg SL, Humphrey TC. The spliceosome-associated protein Nrl1 suppresses homologous recombination-dependent R-loop formation in fission yeast. *Nucleic Acids Res*. 2016 Feb 29;44(4):1703-17.
5. Starokadomskyy P, Gemelli T, Rios JJ, Xing C, Wang RC, Li H, Pokatayev V, Dozmorov I, Khan S, Miyata N, Fraile G, Raj P, Xu Z, Xu Z, Ma L, Lin Z, Wang H, Yang Y, Ben-Amitai D, Orenstein N,

- Mussaffi H, Baselga E, Tadini G, Grunebaum E, Sarajlija A, Krzewski K, Wakeland EK, Yan N, de la Morena MT, Zinn AR, Burstein E. DNA polymerase- α regulates the activation of type I interferons through cytosolic RNA:DNA synthesis. *Nat Immunol.* 2016 May;17(5):495-504.
6. Abraham KJ, Chan JN, Salvi JS, Ho B, Hall A, Vidya E, Guo R, Killackey SA, Liu N, Lee JE, Brown GW, Mekhail K. Intersection of calorie restriction and magnesium in the suppression of genome-destabilizing RNA-DNA hybrids. *Nucleic Acids Res.* 2016 Oct 14;44(18):8870-8884.
 7. Sridhara SC, Carvalho S, Grosso AR, Gallego-Paez LM, Carmo-Fonseca M, de Almeida SF. Transcription Dynamics Prevent RNA-Mediated Genomic Instability through SRPK2-Dependent DDX23 Phosphorylation. *Cell Rep.* 2017 Jan 10;18(2):334-343. doi: 10.1016/j.celrep.2016.12.050.
 8. Carolina A Novoa, Emily Yun-Chia Chang, Maria J Aristizabal, Yan Coulombe, Romulo Segovia, Yaoqing Shen, Christelle Keong, Steven JM Jones, Jean-Yves Masson, Michael S Kobor, Peter C Stirling. Conserved roles of RECQ-like helicases Sgs1 and BLM in preventing R-loop induced genome instability. *bioRxiv.* 2017 Mar 23; doi: <https://doi.org/10.1101/119677>.
 9. Sridhara SC, Carvalho S, Grosso AR, Gallego-Paez LM, Carmo-Fonseca M, de Almeida SF. Transcription Dynamics Prevent RNA-Mediated Genomic Instability through SRPK2-Dependent DDX23 Phosphorylation. *Cell Rep.* 2017 Jan 10;18(2):334-343.
 10. Jones SE, Fleuren EDG, Frankum J, Konde A, Williamson CT, Krastev DB, Pemberton HN, Campbell J, Gulati A, Elliott R, Menon M, Selte JL, Brough R, Pettitt SJ, Niedzwiedz W, van der Graaf WTA, Shipley J, Ashworth A, Lord CJ. ATR is a therapeutic target in synovial sarcoma. *Cancer Res.* 2017 Oct 16. pii: canres.2056.2017.
 11. Komseli ES, Pateras IS, Krejsgaard T, Stawiski K, Rizou SV, Polyzos A, Roumelioti FM, Chiourea M, Mourkioti I, Papatrouna E, Zampetidis CP, Gumeni S, Trougakos IP, Pefani DE, O'Neill E, Gagos S, Eliopoulos AG, Fendler W, Chowdhury D, Bartek J, Gorgoulis VG. A prototypical non-malignant epithelial model to study genome dynamics and concurrently monitor micro-RNAs and proteins in situ during oncogene-induced senescence. *BMC Genomics.* 2018 Jan 10;19(1):37.

DNA-RNA Immunoprecipitation (DRIP):

1. Skourti-Stathaki K, Proudfoot NJ, Gromak N. Human senataxin resolves RNA/DNA hybrids formed at transcriptional pause sites to promote Xrn2-dependent termination. *Mol Cell.* 2011 Jun 24;42(6):794-805.
2. Ginno PA, Lott PL, Christensen HC, Korf I, Chédin F. R-loop formation is a distinctive characteristic of unmethylated human CpG island promoters. *Mol Cell.* 2012 Mar 30;45(6):814-25.
3. Bhatia V, Barroso SI, García-Rubio ML, Tumini E, Herrera-Moyano E, Aguilera A. BRCA2 prevents R-loop accumulation and associates with TREX-2 mRNA export factor PCID2. *Nature.* 2014 Jul 17;511(7509):362-5.
4. Chen PB, Chen HV, Acharya D, Rando OJ, Fazio TG. R loops regulate promoter-proximal chromatin architecture and cellular differentiation. *Nat Struct Mol Biol.* 2015 Dec;22(12):999-1007. doi: 10.1038/nsmb.3122.
5. Wiedemann EM, Peycheva M, Pavri R. DNA Replication Origins in Immunoglobulin Switch Regions Regulate Class Switch Recombination in an R-Loop-Dependent Manner. *Cell Rep.* 2016 Dec 13;17(11):2927-2942.
6. Li L, Matsui M, Corey DR. Activating frataxin expression by repeat-targeted nucleic acids. *Nat Commun.* 2016 Feb 4;7:10606.

7. Zhang R, Wu J, Ferrandon S, Glowacki KJ, Houghton JA. Targeting GLI by GANT61 involves mechanisms dependent on inhibition of both transcription and DNA licensing. *Oncotarget*. 2016 Dec 6;7(49):80190-80207. doi: 10.18632/oncotarget.13376.
8. Esanov R, et al. A C9ORF72 BAC mouse model recapitulates key epigenetic perturbations of ALS/FTD. *Mol Neurodegener*. 2017 Jun 12;12(1):46.
9. Brönnner C, et al. Accumulation of RNA on chromatin disrupts heterochromatic silencing. *Genome Res*. 2017 Apr 12.
10. Sagie S, Toubiana S, Hartono SR, Katzir H, Tzur-Gilat A, Havazelet S, Francastel C, Velasco G, Chédin F, Selig S. Telomeres in ICF syndrome cells are vulnerable to DNA damage due to elevated DNA:RNA hybrids. *Nat Commun*. 2017 Jan 24;8:14015. doi: 10.1038/ncomms14015.
11. Jangi M, Fleet C, Cullen P, Gupta SV, Mekhoubad S, Chiao E, Allaire N, Bennett CF, Rigo F, Krainer AR, Hurt JA, Carulli JP, Staropoli JF. SMN deficiency in severe models of spinal muscular atrophy causes widespread intron retention and DNA damage. *Proc Natl Acad Sci U S A*. 2017 Mar 21;114(12):E2347-E2356. doi: 10.1073/pnas.1613181114.
12. Su XA, Freudenreich CH. Cytosine deamination and base excision repair cause R-loop-induced CAG repeat fragility and instability in *Saccharomyces cerevisiae*. *Proc Natl Acad Sci U S A*. 2017 Sep 18. pii: 201711283.
13. Velazquez Camacho O, Galan C, Swist-Rosowska K, Ching R, Gamalinda M, Karabiber F, De La Rosa-Velazquez I, Engist B, Koschorz B, Shukeir N, Onishi-Seebacher M, van de Nobelen S, Jenuwein T. Major satellite repeat RNA stabilize heterochromatin retention of Suv39h enzymes by RNA-nucleosome association and RNA:DNA hybrid formation. *Elife*. 2017 Aug 1;6. pii: e25293.
14. Brönnner C, Salvi L, Zocco M, Ugolini I, Halic M. Accumulation of RNA on chromatin disrupts heterochromatic silencing. *Genome Res*. 2017 Jul;27(7):1174-1183.
15. Lang KS, Hall AN, Merrih CN, Ragheb M, Tabakh H, Pollock AJ, Woodward JJ, Dreifus JE, Merrih H. Replication-Transcription Conflicts Generate R-Loops that Orchestrate Bacterial Stress Survival and Pathogenesis. *Cell*. 2017 Aug 10;170(4):787-799.e18.
16. Choi J, Hwang SY, Ahn K. Interplay between RNASEH2 and MOV10 controls LINE-1 retrotransposition. *Nucleic Acids Res*. 2018 Feb 28;46(4):1912-1926. doi:10.1093/nar/gkx1312.
17. Kenta Iijima, Junya Kobayashi and Yukihito Ishizaka. Structural alteration of DNA induced by viral protein R of HIV-1 triggers the DNA damage response. *Retrovirology*201815:8. doi: 10.1186/s12977-018-0391-8.
18. Lu WT, Hawley BR, Skalka GL, Baldock RA, Smith EM, Bader AS, Malewicz M, Watts FZ, Wilczynska A, Bushell M. Drosha drives the formation of DNA:RNA hybrids around DNA break sites to facilitate DNA repair. *Nat Commun*. 2018 Feb 7;9(1):532. doi: 10.1038/s41467-018-02893-x.
19. Julien Brustel, Zuzanna Kozik, Natalia Gromak, Velibor Savic & Steve M. M. Sweet. Large XPF-dependent deletions following misrepair of a DNA double strand break are prevented by the RNA:DNA helicase Senataxin. *Scientific Reports* volume 8, Article number: 3850 (2018).

Immunoblot/Immunoprecipitation:

1. Rigby RE, Webb LM, Mackenzie KJ, Li Y, Leitch A, Reijns MA, Lundie RJ, Revuelta A, Davidson DJ, Diebold S, Modis Y, Macdonald AS, Jackson AP. RNA:DNA hybrids are a novel molecular pattern sensed by TLR9. *EMBO J*. 2014 Mar 18;33(6):542-58.

2. Chen PB, Chen HV, Acharya D, Rando OJ, Fazio TG. R loops regulate promoter-proximal chromatin architecture and cellular differentiation. *Nat Struct Mol Biol.* 2015 Dec;22(12):999-1007. doi: 10.1038/nsmb.3122.
3. Velazquez Camacho O, Galan C, Swist-Rosowska K, Ching R, Gamalinda M, Karabiber F, De La Rosa-Velazquez I, Engist B, Koschorz B, Shukeir N, Onishi-Seebacher M, van de Nobelen S, Jenuwein T. Major satellite repeat RNA stabilize heterochromatin retention of Suv39h enzymes by RNA-nucleosome association and RNA:DNA hybrid formation. *Elife.* 2017 Aug 1;6. pii: e25293.
4. Qian Z, Zhurkin VB, Adhya S. DNA-RNA interactions are critical for chromosome condensation in *Escherichia coli*. *Proc Natl Acad Sci U S A.* 2017 Oct 30. pii: 201711285.
5. Raghunathan N, Kapshikar RM, Leela JK, Mallikarjun J, Bouloc P, Gowrishankar J. Genome-wide relationship between R-loop formation and antisense transcription in *Escherichia coli*. *Nucleic Acids Res.* 2018 Apr 20;46(7):3400-3411. doi: 10.1093/nar/gky118.

Immunocytochemistry (ICC)/Immunohistochemistry (IHC):

1. Ginno PA, Lott PL, Christensen HC, Korf I, Chédin F. R-loop formation is a distinctive characteristic of unmethylated human CpG island promoters. *Mol Cell.* 2012 Mar 30;45(6):814-25.
2. Molès JP, Griez A, Guilhou JJ, Girard C, Nagot N, Van de Perre P, Dujols P. Cytosolic RNA:DNA Duplexes Generated by Endogenous Reverse Transcriptase Activity as Autonomous Inducers of Skin Inflammation in Psoriasis. *PLoS One.* 2017 Jan 17;12(1):e0169879. doi: 10.1371/journal.pone.0169879.
3. Walker C, Herranz-Martin S, Karyka E, Liao C, Lewis K, Elsayed W, Lukashchuk V, Chiang SC, Ray S, Mulcahy PJ, Jurga M, Tsagakis I, Iannitti T, Chandran J, Coldicott I, De Vos KJ, Hassan MK, Higginbottom A, Shaw PJ, Hautbergue GM, Azzouz M, El-Khamisy SF. C9orf72 expansion disrupts ATM-mediated chromosomal break repair. *Nat Neurosci.* 2017 Sep;20(9):1225-1235. doi: 10.1038/nn.4604.

Surface Plasmon Resonance (SPR):

1. Sípová H, Zhang S, Dudley AM, Galas D, Wang K, Homola J. Surface plasmon resonance biosensor for rapid label-free detection of microribonucleic acid at subfemtomole level. *Anal Chem.* 2010 Dec 15;82(24):10110-5.
2. Phillips DD, Garboczi DN, Singh K, Hu Z, Leppla SH, Leysath CE. The sub-nanomolar binding of DNA-RNA hybrids by the single-chain Fv fragment of antibody S9.6. *J Mol Recognit.* 2013 Aug;26(8):376-81.

Electrophoretic Mobility Shift Assay (EMSA):

1. Pohjoismäki JL, Holmes JB, Wood SR, Yang MY, Yasukawa T, Reyes A, Bailey LJ, Cluett TJ, Goffart S, Willcox S, Rigby RE, Jackson AP, Spelbrink JN, Griffith JD, Crouch RJ, Jacobs HT, Holt JJ. Mammalian mitochondrial DNA replication intermediates are essentially duplex but contain extensive tracts of RNA/DNA hybrid. *J Mol Biol.* 2010 Apr 16;397(5):1144-55.

HybMap RNA-DNA hybrid mapping:

1. Boguslawski SJ, Smith DE, Michalak MA, Mickelson KE, Yehle CO, Patterson WL, Carrico RJ. Characterization of monoclonal antibody to DNA:RNA and its application to immunodetection of hybrids. *J Immunol Methods*. 1986 May 1;89(1):123-30.
2. Hu Z, Zhang A, Storz G, Gottesman S, Leppla SH. An antibody-based microarray assay for small RNA detection. *Nucleic Acids Res*. 2006 Apr 13;34(7):e52.
3. Dutrow N, Nix DA, Holt D, Milash B, Dalley B, Westbroek E, Parnell TJ, Cairns BR. Dynamic transcriptome of *Schizosaccharomyces pombe* shown by RNA-DNA hybrid mapping. *Nat Genet*. 2008 Aug;40(8):977-86.

Fluorescent *in situ* Hybridization (FISH):

1. Székvölgyi L, Rákósy Z, Bálint BL, Kókai E, Imre L, Vereb G, Bacsó Z, Goda K, Varga S, Balázs M, Dombrádi V, Nagy L, Szabó G. Ribonucleoprotein-masked nicks at 50-kbp intervals in the eukaryotic genomic DNA. *Proc Natl Acad Sci U S A*. 2007 Sep 18;104(38):14964-9.

Microarray assay for DNA/RNA detection

1. Hu Z, Zhang A, Storz G, Gottesman S, Leppla SH. An antibody-based microarray assay for small RNA detection. *Nucleic Acids Res*. 2006 Apr 13;34(7):e52.

Immuno-EM Labeling

1. Jiang YF, Lin SS, Chen JM, Tsai HZ, Hsieh TS, Fu CY. Electron tomographic analysis reveals ultrastructural features of mitochondrial cristae architecture which reflect energetic state and aging. *Sci Rep*. 2017 Mar 30;7:45474.

In situ proximal ligation assay (PLA)

2. Okamoto Y, Iwasaki WM, Kugou K, Takahashi KK, Oda A, Sato K, Kobayashi W, Kawai H, Sakasai R, Takaori-Kondo A, Yamamoto T, Kanemaki MT, Taoka M, Isobe T, Kurumizaka H, Innan H, Ohta K, Ishiai M, Takata M. Replication stress induces accumulation of FANCD2 at central region of large fragile genes. *Nucleic Acids Res*. 2018 Apr 6;46(6):2932-2944. doi: 10.1093/nar/gky058.

Other:

1. Yehle CO, Patterson WL, Boguslawski SJ, Albarella JP, Yip KF, Carrico RJ. A solution hybridization assay for ribosomal RNA from bacteria using biotinylated DNA probes and enzyme-labeled antibody to DNA:RNA. *Mol Cell Probes*. 1987 Jun;1(2):177-93.
2. Miller CA, Patterson WL, Johnson PK, Swartzell CT, Wogoman F, Albarella JP, Carrico RJ. Detection of bacteria by hybridization of rRNA with DNA-latex and immunodetection of hybrids. *J Clin Microbiol*. 1988 Jul;26(7):1271-6.
3. Casebolt DB, Stephensen CB. Monoclonal antibody solution hybridization assay for detection of mouse hepatitis virus infection. *J Clin Microbiol*. 1992 Mar;30(3):608-12.
4. Tran HV, Piro B, Reisberg S, Duc HT, Pham MC. Antibodies directed to RNA/DNA hybrids: an electrochemical immunosensor for microRNAs detection using graphene-composite electrodes. *Anal Chem*. 2013 Sep 3;85(17):8469-74.
5. Starokadomskyy P, Gemelli T, Rios JJ, Xing C, Wang RC, Li H, Pokatayev V, Dozmorov I, Khan S, Miyata N, Fraile G, Raj P, Xu Z, Xu Z, Ma L, Lin Z, Wang H, Yang Y, Ben-Amitai D, Orenstein N,

- Mussaffi H, Baselga E, Tadini G, Grunebaum E, Sarajlija A, Krzewski K, Wakeland EK, Yan N, de la Morena MT, Zinn AR, Burstein E. DNA polymerase- β regulates the activation of type I interferons through cytosolic RNA:DNA synthesis. *Nat Immunol.* 2016 Mar 28.
6. Torrente-Rodríguez RM, Ruiz-Valdepeñas Montiel V, Campuzano S, Farchado-Dinia M, Barderas R, San Segundo-Acosta P, Montoya JJ, Pingarrón JM. Fast Electrochemical miRNAs Determination in Cancer Cells and Tumor Tissues with Antibody-Functionalized Magnetic Microcarriers. *ACS Sensors.* 2016 Jun 10;1(7):896-903.
 7. Dumelie JG, Jaffrey SR. Defining the location of promoter-associated R-loops at near-nucleotide resolution using bisDRIP-seq. *Elife.* 2017 Oct 26;6. pii:e28306.
 8. Qian Z, Zhurkin VB, Adhya S. DNA-RNA interactions are critical for chromosome condensation in *Escherichia coli*. *Proc Natl Acad Sci U S A.* 2017 Oct 30. pii: 201711285.
 9. Vargas E, Torrente-Rodríguez RM, Ruiz-Valdepeñas Montiel V, Povedano E, Pedrero M, Montoya JJ, Campuzano S, Pingarrón JM. Magnetic Beads-Based Sensor with Tailored Sensitivity for Rapid and Single-Step Amperometric Determination of miRNAs. *Int J Mol Sci.* 2017 Nov 9;18(11). pii: E2151.